JUNE 1924 25 CENTS

The Wireless Age

"Enjoy Summer Radio"

Features in this Issue

Newest Development
The D-Coil Receiver
By its designer, K. M. MacIlvain

The Cruise of the "Ara"
W. K. Vanderbilt's Yacht

Radio for Boatmen Motorists & Hikers

Construction of a Portable Receiver
Described by M. B. Sleeper

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Vol. XI No. 9

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Your Authors

WALT. S. THOMPSON, JR. (Telephone Conversation by Radio) made his first radio set as a boy in 1914, and has studied and experimented with radio ever since. During the war he was connected with radio in the U. S. Naval Air Service. Since leaving the service he has been pursuing studies in electrical engineering and doing advanced graduate work on radio communication at Lehigh University. He informs us that his principal hobby is fishing—not DX fishing either, but the old-fashioned piscatorial sort.

WE are pleased to note that Hall E. Shepherd (Radio on Mount Marcy) who has been completing some research work at Yale University, has just been admitted to the practice of law. We wish for him the attainment of fresh mountain peaks in his chosen profession.

W. F. CROSBY (Radio for Boatman, Motorist or Hiker) has been a radio amateur since 1907. He was in the marine business for twelve years, designing, testing and building motor-boats and yachts. He is now interested in the full exploitation of radio in motor-boating. Mr. Crosby was responsible for the beginning of the first New York radio supplement—that of the *Globe*. He also started the Amateur Modulator which he conducted for two years.

K. M. MacIlvain (D-Coil Receiver) graduated from Tufts College. He then served in the Navy as an operator, stationed at London, England. Following the war, he entered the service of the Radio Corporation of America in the traffic and engineering departments. He was transferred to Belmar, N. J., for engineering on marine transmission and reception. There he assisted in the design and construction of marine transmitters now used in Marion, Mass., for transmission to ships at sea. He is now engaged in the development work of Trans-Oceanic reception for the Radio Corporation. Mr. MacIlvain reports three children, all interested in radio.

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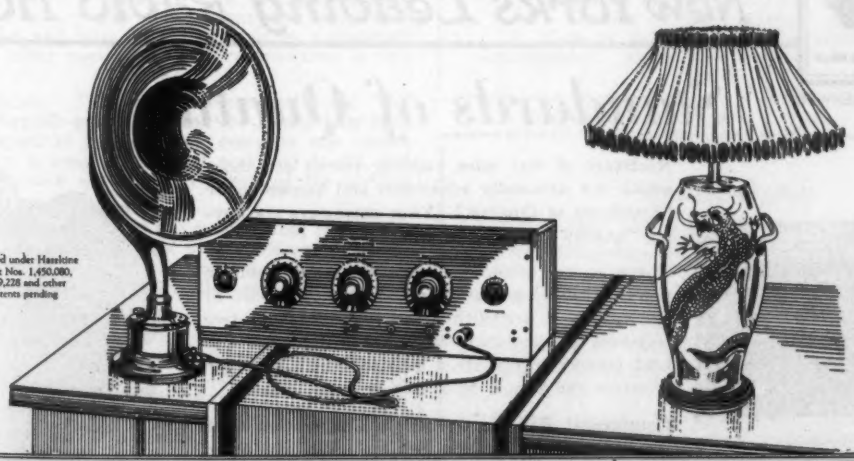

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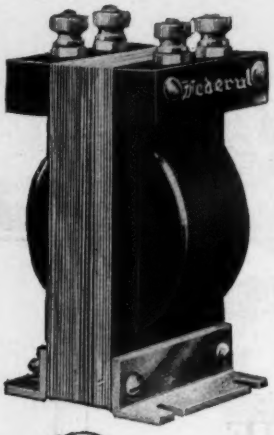

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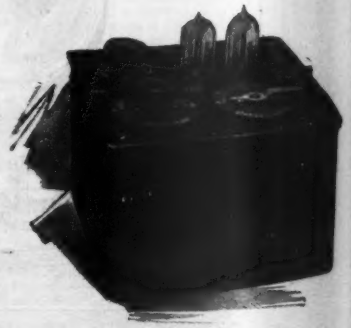

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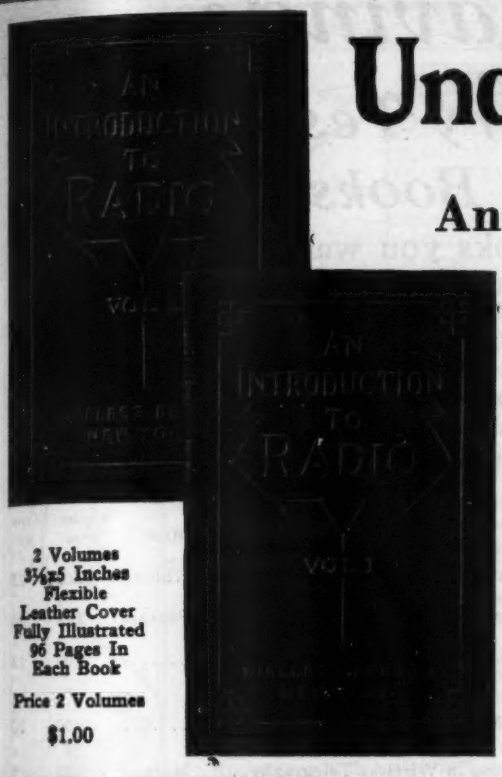

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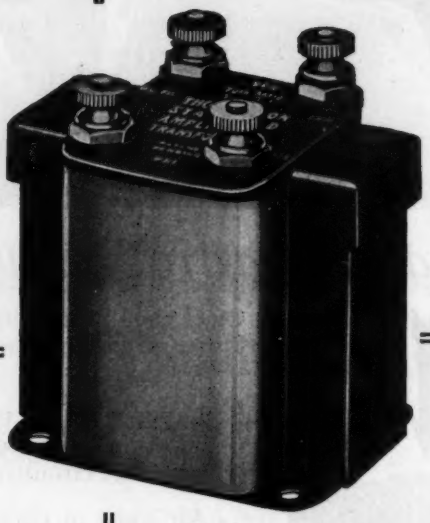

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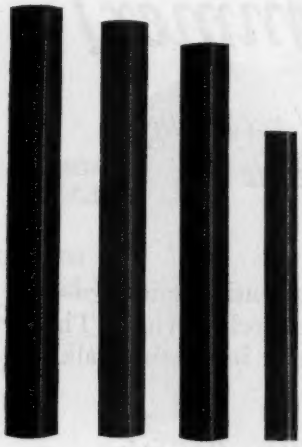

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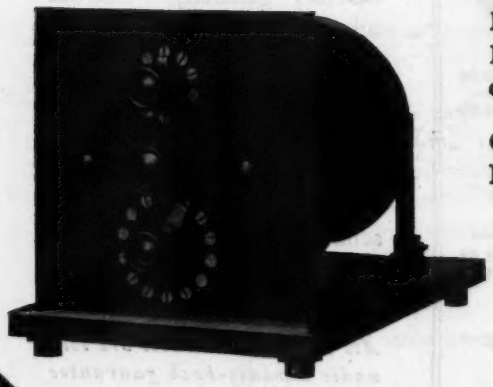

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THE efficiency, the appearance and the price of this new instrument clearly reflect the research and production facilities of The Magnavox Company, largest builders of radio reproducing equipment in the world.

Its exquisite tone quality results from a further perfecting of the Magnavox semi-dynamic operating principle—magnetically balanced armature, improved diaphragm and extremely high resistance winding.

Beautifully finished in dark enamel with gold high lighting, the graceful appearance of M4 suggests its use in the most dignified surroundings.

The amazingly low price of this Magnavox Reproducer establishes an absolutely new standard of value in the radio industry.

M 4

$25.00

Requires no Battery

THE MAGNAVOX CO., OAKLAND, CALIF.

New York Office: 350 West 31st Street

Canadian Distributors—Perkins Electric Limited, Toronto, Montreal, Winnipeg

6B

MAGNAVOX

The Reproducer Supreme

Editorial Chat

FOUR new broadcasting stations this summer is the contribution of the British Broadcasting Company to the delight of the DX hounds. British radio fans are as determined as we on this side of the Atlantic to enjoy broadcasting to the full this summer. While as for us—we are going ahead with the construction of seven new Class B stations and have as many more planned. This summer will find nearly every fan practically in the shadow of a powerful broadcasting station and getting clear and satisfying programs without difficulty.

* * *

HOW about Programs? It is natural to discover analogies between radio and the stage. Stage programs, of several varieties, have been the outgrowth of centuries of spectacles. There were spectacles in the Stone Age. The Roman populace jeered and cheered at spectacles in the arena where the program manager put on hungry beasts and mixed in men and women to provide human—or inhuman—interest. The mystery and miracle plays, the Elizabethan drama, the wandering troupes of players—all had their programs. And radio broadcasting falls heir to them all. What an unlimited scope for the ingenuity of radio program managers!

* * *

THE stage has always had its vaudeville programs. But vaudeville is not the most significant contribution of the stage to civilization and human happiness. By the same token, radio program progress is going to be measured by the steps it removes itself from the primitive vaudeville. Admittedly, radio programs must offer variety. The field of radio listeners is large and variegated. Programs must please all classes. To hold listeners, numbers must be short. The variety program, therefore, is the rule in broadcast studios. Will it always be so?

* * *

HAPPILY, some broadcasting stations are not content to follow the crowd, and are producing real things often enough to indicate that it is not just happenstance. For instance—Minstrelsy, Past and Present. What more appropriate framework could be imagined about which to entwine an evening's radio concert! We congratulate the station manager who was blessed with this happy idea. And we hope that the variations on this motif will be legion. Like a golden pageant from the past! Early minstrelsy; the first minstrel, David in the court of Saul; Minstrelsy at King Arthur's Round Table; the troubadours; the Irish minstrels, Yankee Hill, the first American minstrel; finally modern minstrelsy otherwise known, we suppose, as Jazz! How's this for a musical banquet!

* * *

MINSTRELSY, Past and Present, is representative of only one possibility. There are many others. And it is pleasant to note that some program directors are endeavoring to formulate programs that will possess the necessary variety, but will at the same time evolve and elaborate a central theme and be expressive of something. The stations that succeed best in this effort will capture the most listeners.

THE radio vaudeville, unlike stage vaudeville, cannot confine its audience within four gilded walls and hold them there. If other stations are likewise sending out variety stuff which—so the listener thinks—may be better, a twirl of the dial will gather in the best from a flock of stations. No, Mr. Program Man, your variety stuff will hold us but for a brief half hour—or less. But, as suggested, there are other possibilities. Some day there will be less of the vaudeville performance, and more of the carefully planned *radio evening*, so unified and complete in itself, yet so spiced with variety withal, that one will never be tempted to tune in the other fellow.

* * *

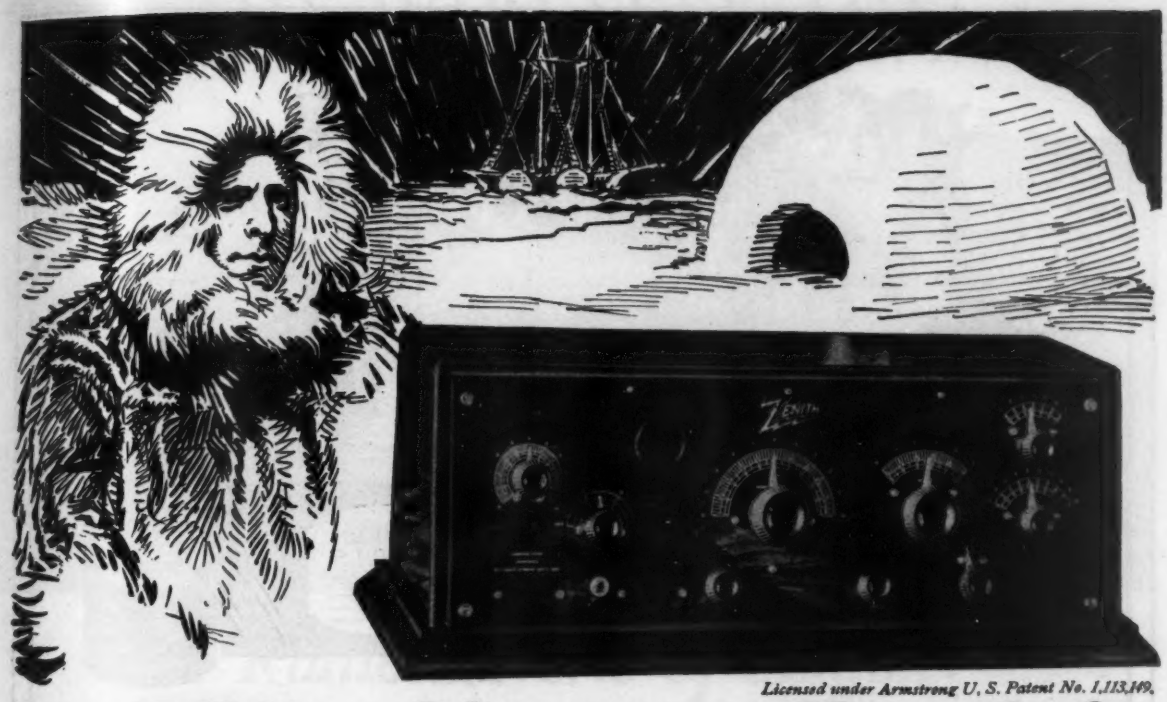
HOW puffed up our newspaper editor tribe should be! A prominent individual of the radio industry has asserted his belief that every broadcasting station should be associated with and controlled by a large newspaper, for, says he, the corps of editors of a newspaper are well qualified to know what the public wants. Probably so. And if so, why not put the moving picture business in charge of newspaper editors? (One newspaper editor has made a decided success as a movie director.) Also, why stop here? Let's put newspaper editors in charge of our theaters; and, if knowledge of what the public wants is to be the principal criterion—of our municipal governments, of our industries. Let's put newspaper editors in charge of everything . . . Possibly it would be well to leave some lawyers functioning in our legal system, and some financiers in our banking, and some engineers in our construction development, and—when we get through with connecting up specialists with specialties, we shall probably want to see newspaper editors editing, and broadcasters—broadcasting. If a newspaper editor should chance to develop proclivities of the radio broadcast order, the newer calling will welcome him. But why close the door upon a lot of other talented chaps who are not so fortunate as to be newspaper editors? Radio broadcasting wants the biggest caliber men it can find to put in its studios.

* * *

THE proposed Federal ten per cent. radio tax failed of enactment, of course. Did anyone learn of a single argument advanced in its favor?

* * *

RADIO broadcasting is not—in the opinion of Federal Judge Smith Hickenlooper—a public performance, as the framers of the copyright law understood the term. This decision in favor of The Crosley Manufacturing Company in the suit preferred against it by Remick & Co., music publishers, becomes thus a noteworthy episode in the dispute between broadcasters and the American Society of Composers, Authors and Publishers over the broadcasting of copyrighted music. This decision and its supporting reasoning tallies with the tenor of the argument and testimony presented in the hearings on the Dill Bill, recently concluded, which were highly favorable to this bill designed to relieve radio broadcasting of its present copyright handicap.



Licensed under Armstrong U. S. Patent No. 1,113,149.

MacMillan Listens to Honolulu and New Zealand "Tunes In" California

Using

ZENITH

TRADE MARK

Long-Distance Radio

From a little ice-bound schooner—eleven degrees from the North Pole—comes this message:

"Am very thankful that Arctic Exploring Ship Bowdoin is equipped with complete Zenith radio apparatus. Here at top of world, in darkness of great Arctic night, we have already listened to stations practically all over United States, from Europe, and even from far away Honolulu. Zenith has united the ends of the earth."

—"MacMillan"

Again, from far-off New Zealand comes a report of radio reception even more startling:

"It may interest you to know that the writer last evening landed KGO, Oakland, California, between 6:45 and 7:30 P. M. Heard his call four or five times distinctly, and jazz music. The music was not as clear as the voice, but one could pick up the tune all right. As San Francisco is ***6,300 miles from New Plymouth,*** and only one tube was used, we think this is a very fair performance."

—(signed) H. Charles Collier.

The sets used by Captain MacMillan and Mr. Collier are earlier models—since improved by the addition of ***a third stage of audio frequency.*** These new models, described at the right, represent an achievement in radio construction not duplicated in any other set on the market. A demonstration will convince you.

Write today for full particulars and name of nearest dealer.

Zenith Radio Corporation

McCORMICK BUILDING, CHICAGO

Model 3R The new Zenith 3R "Long-Distance" Receiver-Amplifier combines a specially designed distortionless three-stage amplifier with the new and different Zenith three-circuit regenerative tuner.

Fine vernier adjustments—in connection with the unique Zenith aperiodic or non-resonant "selector" primary circuit—make possible extreme selectivity.

The new Zenith 3R has broken all records, even those set by its famous predecessors of the Zenith line. Under favorable conditions, satisfactory reception over distances of 2,000 to 3,000 miles, and over, is often accomplished in full volume, using ***any ordinary loud-speaker.*** The Model 3R is compact, graceful in line, and built in a highly finished mahogany cabinet..... $160

Model 4R The new Zenith 4R "Long-Distance" Receiver-Amplifier comprises a complete three-circuit regenerative receiver of the feed-back type. It employs the new Zenith regenerative circuit in combination with an ***audion detector*** and ***three-stage*** audio-frequency amplifier, all in one cabinet.

Because of the unique Zenith "selector," unusual selectivity is accomplished without complication of adjustment.

The Zenith 4R may be connected directly to any loud-speaker ***without*** the use of other amplification for full phonograph volume, and reception may be accomplished over distances of more than 2,000 miles..... $85

ZENITH RADIO CORPORATION,
Dept. 1-L 328 South Michigan Avenue, Chicago, Illinois

Gentlemen:
Please send me illustrated literature on Zenith Radio.

Name.....

Address.....

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"

No. 766 "B" Battery, 22½ volts

More Power for Summer Radio

WHEN you take radio away with you—take Eveready Radio "A" and "B" Batteries, the batteries whose great power lasts longer. Remember, summer's the time when radio signals are weaker.

Batteries do get used up in time. The ones you've been using, though partly exhausted, may be satisfactory for the strong winter signals, but are probably inadequate for the weaker summer signals.

For instance, use the familiar standard 22½-volt Eveready "B" Battery No. 766. It has variable taps for "soft" detector tubes. Put two, three or four in series to provide sufficient power for amplifiers.

To light the filaments of your dry cell vacuum tubes for the longest time, use Eveready Dry Cell Radio "A" Battery No. 7111. The Eveready "A" will astonish you by its long-sustained vigor. It is advisable to use two Eveready "A's" connected in multiple for each WD-11 or WD-12 tube—this gives the economical "eighth" ampere drain per cell which insures maximum economy and longer life. For sets employing one to three UV-199 tubes use three Eveready Dry Cell Radio "A" Batteries No. 7111 connected in series.

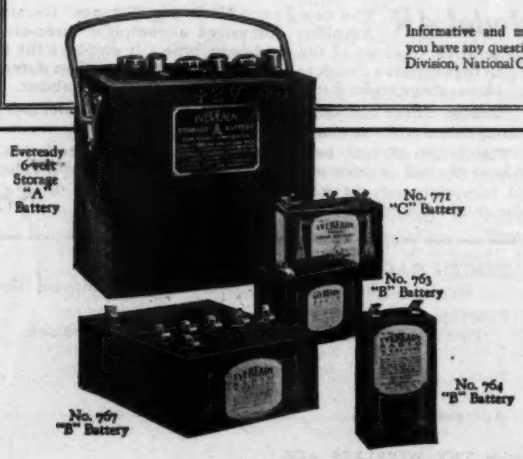
The greatest electro-chemical laboratory known created these famous dry cell batteries on which radio largely depends. The experience of thirty years in battery making stands back of them.

Eveready Radio "A" and "B" Batteries—lively, peppy, long-lived producers of power.

For your light-weight sets to take camping or on hikes, Eveready has suitable small batteries.

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, INC., New York—San Francisco
Headquarters for Radio Battery Information
Canadian National Carbon Co., Limited, Toronto, Ontario

Informative and money-saving booklets on radio batteries sent free on request. If you have any questions regarding radio batteries, write to G. C. Furness, Manager, Radio Division, National Carbon Company, Inc., 198 Orton Street, Long Island City, N.Y.



EVEREADY
Radio Batteries
—they last longer

VOLUME 11

THE WIRELESS AGE

"America's Foremost Radiophone Review"

NUMBER 9

A Radio Reverie of Summer

BROADCAST stations are planning elaborate summer programs. Programs that will be broadcast with increased power. Programs of culture; of education; of entertainment.

The ocean waves will be broadcast from Atlantic City. The swish and boom of the breakers will reach the bed-ridden folk in hospitals.

The Democratic and Republican National Conventions will be held in New York and Cleveland during the month of June. While milling thousands swelter under auditorium roofs, radio millions will enjoy the Convention highlights under spruce boughs, on club verandas, in lake boats, and on front porches of an evening.

Summer sports, baseball, tennis, and boat races will go on the air. The open air band concerts of the parks will be broadcast.

All to be had for the tuning-in.

East or West is the seashore.

With the long rambling "Ls" and the wide, banistered porches of the sea-side hotel come our memories of the gala-day throngs leisurely strolling about on the spacious board walks. A group here, and a group there, discovering a gaudy array of souvenir booths with their baubles of canes and salt-water taffy temptingly arranged on tinseled shelves; gay little parties beneath red-striped awnings, scattered about on a green lawn; sober groups tucked away in the corners of the cool Palm Grotto; twos and threes, with tanned faces and sunburned arms, clad in vari-colored bathing suits lounging under the umbrellas stuck in the white, glistening sand, or racing down the beach and out into the breakers; music and gay laughter floating across the water from yachts idling off shore.

Glance again at the gay caparisoned seashore resort. The radio is there, because it adds to the things we like best.

Early up and out on the porch to see a sunrise in the mountains. We lean against the bark-log rail and strive to pierce the lavender shadows still hovering over the valley, two thousand feet below. The clear, translucent surface of Mirror Lake, streaked with shades of crimson and blue, reflects the heightening color of the morning sky. The evergreens and mountain ash on the distant shore carpet the valley like a rolling, moss-covered tundra. And up the mountain side they straggle out into squat bushes, then become more distinct as they reach the timber line. A riot of bright colored flowers cover a hillside that had been swept by a forest fire.

The sky has become a clear azure, with but one pink streamer melting into the zenith as the last remnant of a glorius sunrise warns us that another day of activity has begun. Hikes to be taken; long tortuous trails to explore; a picnic lunch on a rocky peak; a line cast into the icy water of a trout brook; a dip in the lake; and back again under the cool roof of pine boughs, to a supper of venison, and a dance in the evening. An evening of music that our radio provides.

The fascination of a city's pleasure in the wild, untamed realm of the mountains.

In an out-of-the-way corner, only known to vacationists, we have found an inland lake. A modest summer hotel is tucked away at one end. Around the bend, where the trees overhang the water edge, we find small screened-in cottages sheltering a neighborly group of families, crowded and happy, released from the inhibitions of side-street society, the ruthless tyranny of town existence.

We can spend a lazy, care-free afternoon on the porch, reading a novel, or listening in on the radio. Or perhaps we'd rather fish. With a box of tackle, a pail of minnows and a portable receiver, we can row from shore, and to the strains of an orchestra troll for pike.

In the evenings we have the best in news and entertainment by radio. On a Sunday we gather in the old fashioned parlor of the hotel for the religious services broadcast from the temples of worship in the great cities.

We have the best of our civilization in the peace and quiet of woods and lakes.

Those of us who are city-bound—shackled to a desk in the oven heat of an office building, grinding away under the irritating draft of an electric fan—those are the ones of us who will know the value of radio this summer.

We can find surcease from the tense, vibrating grip of the day's business at our radio of an evening.

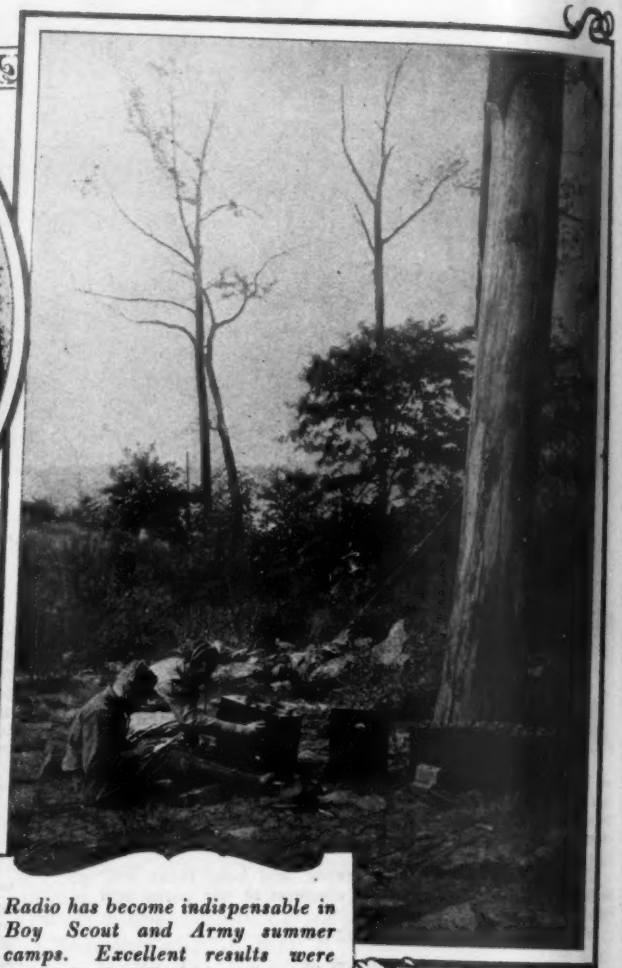
We can have a garden party, or a lawn fête, during the longer daylight evenings. The best metropolitan hotel orchestras will play for us.

We can lounge on our front porch and listen to broadcast talks on week-end motor trips; where to go, and how; when to go, and why.

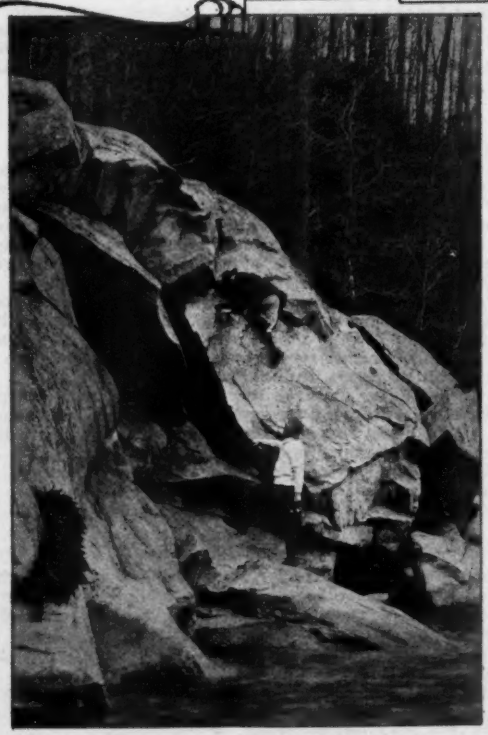
On a Sunday we can drive to the neighboring woods for a picnic lunch. And under the spreading branches of an oak, listen in to religious services, mingled with the strains of an organ, the best of majestic cathedrals brought to us in the sanctity of peace and rest in the open air.

Enjoying Summer Radio and—

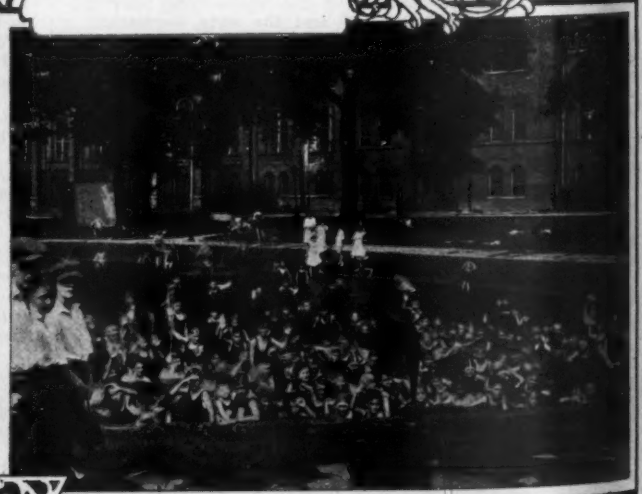
Radio dispelled the loneliness when getting the garden ready at this summer cottage before the family arrived



Radio has become indispensable in Boy Scout and Army summer camps. Excellent results were obtained with this equipment



A natural cave runs in to the left and cannot be approached other than down the rocks as shown. After the radio had been installed the retreat was transformed into a homelike camp



Through radio, the youngsters are receiving swimming lessons broadcast from WLW. These classes are under the auspices of the Y. M. C. A.

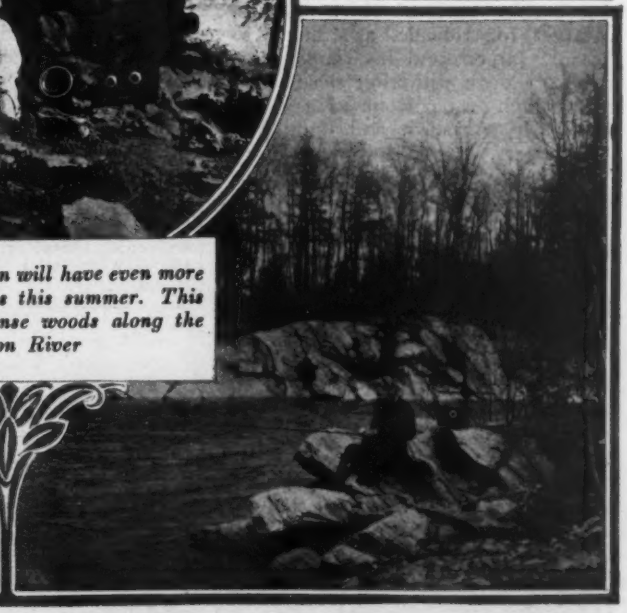
Woodland, Stream and Sea Shore

A book of verses, a bit of lunch and the radio underneath a bow—a pleasant hike the more pleasant because of radio

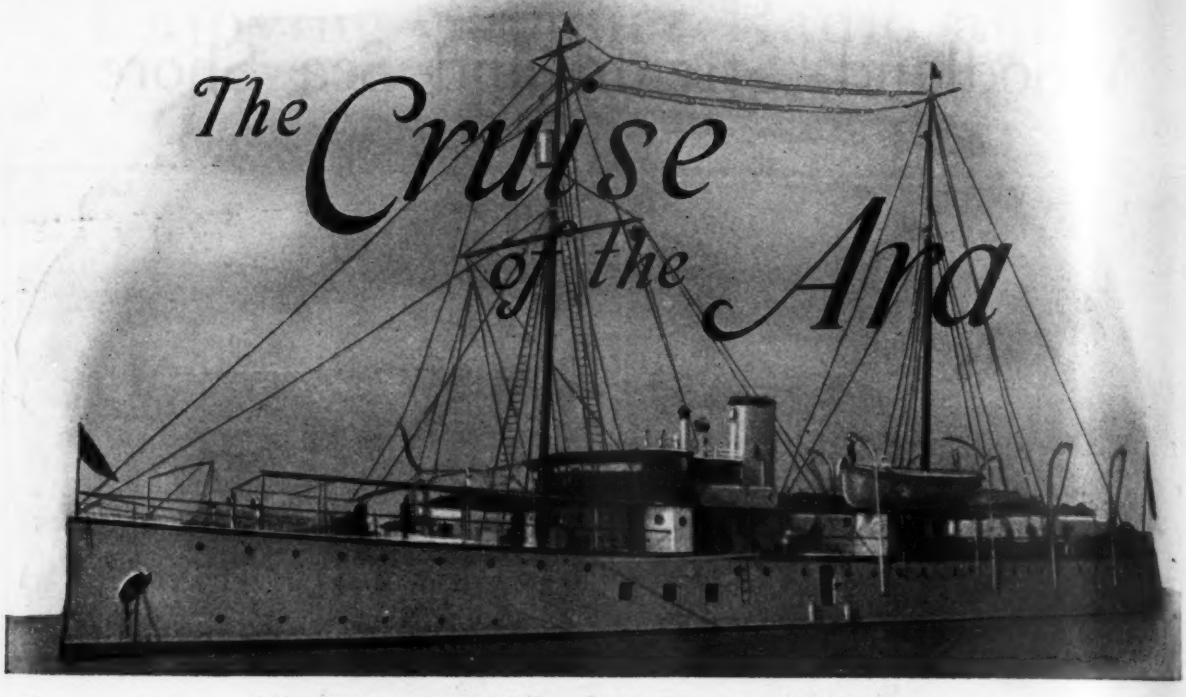
Radio on the beaches this summer will be a part of summer vacationing and sports. It can best be enjoyed beneath an umbrella between times of dips in the sea

A log cabin vacation will have even more lure for radio fans this summer. This scene is in the dense woods along the Hudson River

This is an example of what can be done with a good portable set on the camping trip this summer. The aerial is a single wire thrown over the limb of a nearby tree



The hours of fishing can be considerably lightened with a good radio set. This is a six-tube set. The labor of carrying the dry batteries was well worth the result



The Story of a Millionaire's Yacht. What Radio Means to Mr. W. K. Vanderbilt Aboard the "Ara"

By William A. Hurd

SAILORS, ashore, enjoy the privilege of using sea-going phraseology to the confoundment and envy of all landlubbers. Such is a mark of distinction.

But once a son of the soil climbs aboard ship—he is an object of pity, a target for ridicule, a stranger to Oceanic Jargon, and his criminal ignorance is dealt with after the fashion of the high-seas custom. He is expeditiously squashed, and flung into the scuppers.

A floor's a deck, a kitchen's a galley and a stairway's a ladder. Every salt knows it, down to the last sea-dog who has roamed the highways and the byways of the seven seas.

So we'd better look sharp to our riggin'—we're going on a cruise. The cruise of the *Ara*.

A trim little yacht, the *Ara*. 213 ft., fore and aft, with a water displacement of 850 tons, equipped with two 1,050 H. P. Diesel engines and run by a crew of thirty-two men and officers.

The Commodore, W. K. Vanderbilt, railroad financier and scion of the well known Vanderbilt family, purchased the *Ara* following the Great War, and refitted the yacht to suit his needs. Since the total cost was approximately $500,000, one might gather that yachting is, indeed, a luxury. And one is correct—members of the crew consider it a luxury to work on the *Ara*.

Four boats are swung on davits: a thirty-foot motor cabin-launch for the Commodore's private use, an eighteen-foot motor dinghy, a twenty-foot motor launch, a twenty-six-foot life boat, and between them, on the superstructure, waterproof lockers contain rigging, auxiliary storage batteries and jars of diluted formaldehyde in which fish specimens are preserved. Nothing to inspire romance there.

The Wireless Age is indebted to Mr. W. K. Vanderbilt's kindness in allowing the writer to go on board the "Ara" in order that a description of the yacht and particulars of the log might be combined in a story. By way of enlivening the story, the writer has on his own initiative added a touch of romance.

Strolling up to the pilot house, signs of life become apparent as the wheel and engine room signal controls are uncovered. The Mate bends over the gyroscope compass checking its working order. When asked, he explains that unlike the magnetic compass, as of old, this one operates electrically from a gyroscope located in the bottom of the ship.

Stepping into the chart room, we find a sailor putting the finishing touches to his brass polishing. The Second Mate is checking the chronometer and arranging the great number of charts and maps. Here, every instrument practicable to navigation may be found. And frequently in duplicate.

Out on the bridge an electrician is testing the electrically controlled Sperry searchlight, fastened above on the foremast. This light is the most powerful built for ships, capable of throwing a strong beam of light several miles.

Leaning over the rail, an increasing hustle and bustle is observed. A pungent odor of whale oil drifts up from below where it is being rubbed on to metal parts that are exposed to salt spray. The davits creak and groan as the provisions are swung aboard. Up forward one of the Boatswains leans against a canvas-covered gun, listlessly checking the supplies as they come over the bulwarks. An almost imperceptible motion of the yacht is detected as she idly swings at her moorings.

Below, the crew's quarters occupy most of the forecastle. Just aft are the officers' quarters and the radio station.

Steffen F. Nielssen, a World War veteran, is in charge of the radio station. Before the war he attended one of the prominent universities in Germany and is conversant with several languages. His first schooling in radio was under the personal direction of Poulsen, inventor of the Poulsen arc transmitter. Later he conducted the radio research work in the laboratories

of the University of Texas for a period of two years.

Just now, he is wholly absorbed with the intricate circuits, looking for a broken wire, a loose connection or any weak point that might cause trouble at sea.

So we'll look around aft where the steward's quarters are located. In these quarters accommodations are provided for six stewards and chef. A laundry is also provided below.

Amidship is a large music room luxuriously furnished with a gray plush carpet, overstuffed lounge and chairs, rare mahogany pieces, a grand player-piano, a console phonograph, floor lamps, a large bookcase containing valuable editions, and side-wall candle fixtures. Loud speakers can be "plugged in" at convenient outlets connected by direct wire to the broadcast receiver which is located in the radio operating room.

Stepping out of the music room, the passageway leads aft between cases of sea and bird specimens, racks of firearms, some of a special sort, and lockers of nearly every conceivable kind of fishing tackle. A sportsman's yacht, and no doubt about it.

Through this passage, entry is had to the sleeping accommodations for the guests. There are six suites, each with private bath. The beds, dressing tables, desks, cabinets and chairs in each suite are of a uniform style. In one, mahogany, another bird's-eye maple, and others, walnut, oak and various costly woods.

Leading up the ladder, we may step into the card room appointed in the fashion of a "club room" coziness. Heavily cushioned benches surround a table, and panels of matched grain form the walls or bulkheads.

The galley (kitchen) is a model of spotlessness, where Commodore Vanderbilt's private chef reigns supreme. The prepared meals are sent below, for the officers and crew, and above, for the guests, on a dumb-waiter. Should any of the company be delayed, the food is kept warm in an electric heater.

On the main deck is a large and airy dining saloon which is connected with the pantry from which the food is served. The table is pivoted on gimbals so that it remains on a level plane when the yacht rolls and pitches in high seas.

Going below again, we see the ice-boxes. They resemble the finest in a metropolitan hotel.

Provisions are being stored away for this cruise—chickens, meat, canned goods and an infinite variety of delicacies that make our mouths water, merely to contemplate the good "feeds" ahead.

But our epicurean reveries are interrupted by a shrill whistle from above. Having gleaned enough sea-etiquette and ship manners by this time to know that a whistle sounded portends something of significance, we scramble up the ladders to investigate the cause.

Commodore Vanderbilt has come aboard. Brisk, orderly activity is evident at every turn. The Commodore, having been a Commander in the Navy, always insists that precise conduct should be the mark of efficient management aboard the *Ara*. And so it is.

His first concern, before casting off, is about the navigation equipment. Then below to inspect the radio.

The radio apparatus is a duplicate, throughout, of that on the *Majestic* of the White Star Line.

Three transmitters are installed; a 1½ K.W. tube transmitter, a 1½ K.W. spark transmitter of the quenched type and a smaller spark transmitter, rated

STATEMENT FROM MR. W. K. VANDERBILT

"It is a pleasure to state that radio has been a useful hobby as well as a really worth while diversion.

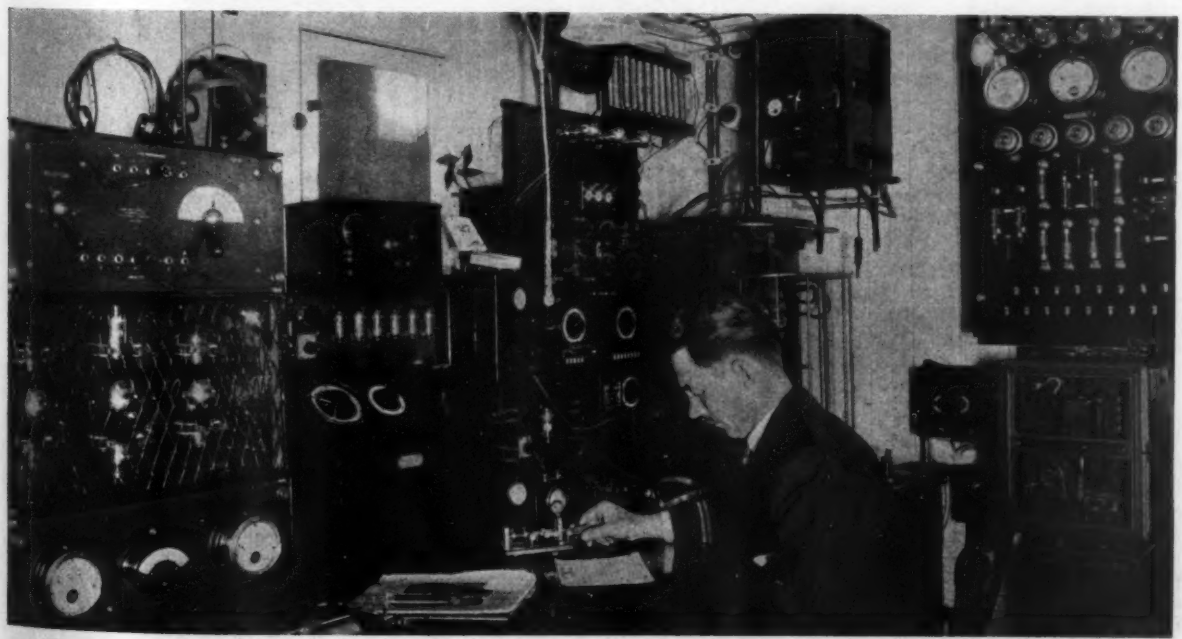
"At times I am several thousand miles from home and the office. In the past I have been at a loss to know what might have happened during my absence, and the knowledge that something might be wrong has frequently been uncomfortable since I would not hear of it until many days later. But now I am in constant touch with home affairs, and possible business matters that might require immediate attention. And this is possible through the modern radio equipment on the Ara.

"The reception of news has added much to the comfort of my crew, guests and myself. Through the agency of radio we enjoy a daily newspaper on board the yacht, however far from the land.

"From a navigating standpoint radio has proved invaluable. The Direction Finder has been a great aid in coastwise sailing. We feel that when within 50 miles of two stations our position can be checked within a degree.

"The time signals and the weather reports, and the fact that one may communicate with the outside world, have all added to the pleasure of a cruise."

—W. K. Vanderbilt.



Isidor P. Nielssen, the operator aboard the "Ara," at work. Left to right is the C. W. transmitter, the direction finder and gyroscopic compass, the two receiving sets and loud speaker (above) and the main spark transmitter (partly hidden by the operator's head). Above the main transmitter is the emergency spark transmitter and to the extreme right is the switchboard, and below, the motor-generator starter.

at ¼ to ½ K.W., intended for emergency use, or for low power transmission.

A motor-generator supplies the power for all three transmitters.

The switchboard carries all the control switches for the main set and the emergency power, besides providing means for charging the storage batteries.

Two receiving sets provide the traffic and broadcast reception. The broadcast receiver is connected to a three-step power amplifier.

Mounted on the table is a radio direction finder that is often more accurate than navigation instruments.

Next to the direction finder is a "repeater," part of the gyroscopic compass system.

Although atmospheric conditions, and many other factors, largely determine the range of any radio equipment, the apparatus aboard the *Ara* consistently maintains a transmission record of 1,500 miles.

Commodore Vanderbilt, well pleased after his inspection, climbed up to the bridge, questioned the Staff Captain on some matters pertaining to the general working order of the ship, and then gave orders to cast off.

* * *

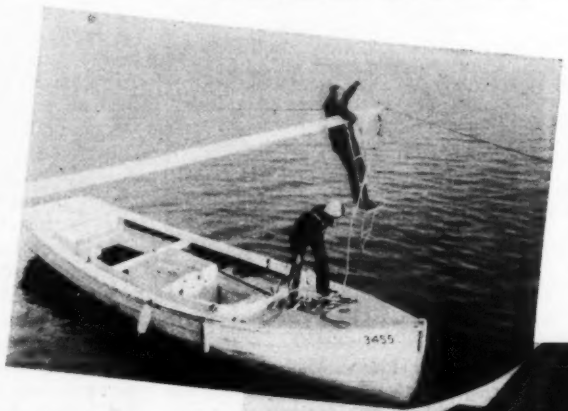
A bell sounded — the engines throbbed — the water boiled and churned away from the stern—the *Ara* swung gracefully from the dock—her nose pointed seaward — long, black rolls breaking into swirling eddies broadened out into a fan-like wake—the topmasts like slender, artistic finger tips seemed to inscribe the words ROMANCE and ADVENTURE on the moist mirror of the sky.

The *Ara* slipped down the Hudson River, tooting her course through a maze of ferries and tug-boats; down between the batteries of wharves and docks; down between sheer cliffs of brick and steel buildings. The evening settled into deepening twilight; lights began to twinkle; red lights, green lights and white lights drifted across the water; the New York skyline melted into a fairyland of gleaming jewels and towers; the far-off, muffled roar of the great city drifted out as from an enchanted world; perhaps it was the trumpeting of heralds from the turrets, proclaiming the freedom of souls from another day's toil.

Across the harbor, out into the ocean, the *Ara* nosed along, pointing toward beacon lights, then following the boom of buoy horns; still out, around Sandy Hook, and at last, straightaway, due South!

The following day, the *Ara* pulled up in the sheltered water of Chesapeake Bay long enough to cast over some lines. But fisherman's luck had stayed ashore. Other than three or four small sharks—disparagingly referred to by the natives as dog-fish—the only catch that furnished any excitement was a sting-ray. This fish, very much resembling a kite, its mouth about where the kite-string would be attached, spread itself out in such a manner that a three-foot board, hauled broadside through the water, would have offered less resistance.

The Commodore wished to send a few radiograms, so a day was called. The yacht headed out to sea again, and Nielssen cut in the broadcast receiver for the daily DX dozen.



Most of the guests went ashore to visit the old historic fortress at Fort Jefferson.

In the music room, the Commodore and his party enjoyed a concert from New York, while the crew, below, listened in on another loud speaker.

Four bells sounded on the bridge. Simultaneously the time signals from Arlington flashed the long dash for 10:00 P. M. In the chart room, the Mate checked the chronometer, and then sent the Quartermaster below for the weather reports. Such was the nightly ceremony that radio had dedicated to the precise art of navigation. It was a solemn affair because it was important. A ship at sea must not be left to the caprice of human judgment.

* * *

The *Ara* arrived at Jacksonville with no mishap and a record of fine weather. Milk and fresh vegetables were brought aboard. And then the crew set to the task of scrubbing and painting until the yacht, from topmast to keel, was as ship-shape as a Bo's'n could wish.

The following day, the *Ara* slipped into the harbor at Miami and dropped anchor to await the arrival of the guests.

On the way in, one of the sailors, who had been up in the rigging, swung out on a cable and waited. A few moments later a schooner hove alongside on the way out to sea. The sailor, hanging in mid-air, let go. He soared out over the bridge, gripping the cable with his hands and one leg hooked over the top. He soared out over the pilot house and down; down with increasing velocity; down with a crash to the deck.

The men aboard the schooner had watched, spellbound. An old salt rushed over to the rail, and with cupped hands to his mouth, yelled, "Good work, sailor. Better ship over on a square-rigger afore your sea-l'arnin' runs amuck!"

The sailor grinned acknowledgment. He had been educated on a sailing vessel, and he knew that old timers, alone, would understand the urge that had prompted his little display of vanity—or perhaps it was pride. He looked at his hands. The palms were scorched by oakum, and raw. He grinned again.

The Mate, who watched the episode from the bridge, also grinned.

Two men aboard the *Ara* had known the wild thrill of hanging to a yardarm, taking in a reef against a driving storm, the canvas tearing the flesh from clutching fingers, the topmast slashing through the darkness in terrifying arcs.

The guests came aboard in the evening. Under the clear, Florida moon the party danced on the quarter-deck to the strains of an orchestra broadcasting from New York. Around midnight the music stopped. Stewards brought chairs and cool drinks, and the guests gave themselves up to the luxury of reclining beneath the high, star-dotted vault of a Southern sky. Refreshing zephyrs skipped across the deck. The soothing trickle of water, breaking against the bow, whispered strange yarns of the sea. Delicate, phosphorus-streaked patterns of lace spread over the surface, glowing and

fading, the half-formed pictures, ever elusive, always beyond the grasp of intrigued fancy.

A steward came up to announce that the operator had managed to tune in another orchestra, broadcasting on the Pacific Coast. And did they wish to dance? They did!

An hour later, the party had to retreat to the music room to continue their dance because of the mist that had settled over the harbor. And the dance continued until the last broadcast station had closed for the night.

In the morning, the *Ara* left Miami for Key West for fuel.

Key West is south of America—1,500 miles south of New York—and yet it is indubitably a part of America. It is, in fact, disappointing.

The low wooden houses have wide verandas supported by pillars resembling the tropical abodes of a Latin people. But they smack of our own familiar architecture.

Here and there, a graceful palm tree rises from the curb, the delicate plume-like branches drooping and swaying in the constant sea breezes. For a moment, one can picture the olden days when pirates took refuge in the bosom of these coral islands, scarcely rising above the ultramarine blue of the Caribbean. Then disillusionment. The swarm of automobiles clogging the street corners are very modern. Automobiles can even destroy the tranquil memories and jealously guarded traditions of a sleepy, New England village.

Year-round prevalence of mosquitoes and the acute lack of drinking water irritate the visitor from the States. The natives, however, accept the two evils with a resignation that surpasses the comprehension of restless, American-born citizens who are frequently guilty of acceptance without reason, but never resigned.

Innumerable cigar factories clutter the island. Modern factories, well ventilated by the steady breezes enjoyed in Key West, less pretentious structures down the side streets, and small, single shanties tucked away in stuffy corners of the town, all house the great industry of this natural focus point of material, maker and consumer.

Two sailors from the *Ara* went ashore with a misconceived idea of Key West generosity, and a goodly share of blissful ignorance. It occurred to them that a casual tour through the plants of better cigar manufacturers would result in pockets full of brands ordinarily beyond their means. They found the factories extremely cordial—almost grateful for such unprecedented concern from two perfect strangers—but courtesy in a Key West cigar factory does not include the ritual of tucking samples into comfortably receptive vest pockets.

While the guests aboard the *Ara* sauntered about the town, oil was pumped into the tanks, located in the sides of the yacht.

A sponge boat had just returned from an expedition in the sadly depleted sponge fields of the Florida Keys. The boat reeked with the putrid, nauseating odor of decayed animal matter.

The *Ara* left Key West for a run around to Fort Jefferson. Some of the guests went ashore to see the old historic fort of Civil War days.

The chase after the queer "balloon" fish resulted in the catch of a large jewfish

The few who remained on the yacht whiled away the time by fishing off shore. Three small fish were caught, hardly worth saving, so they were cast out into the water. But one swelled like a balloon and floated away on the tide. A boat was launched to recapture the strange specimen.

Although the balloon-fish could not be found after a diligent search along the course it had been last observed floating out to sea, a large jewfish was caught on a troll-line. This was brought back to the dock, cleaned and preserved for the Commodore's museum.

The following day, the *Ara* was headed around and set on a course for Nassau in the Bahama Islands.

Before land was sighted a strong trade wind blew up from the West Indies. Its velocity increased steadily, followed by giant rollers that broke into whitecaps. The yacht plunged, nose first, into a towering wave. She hesitated for a brief instant; a sheet of green water splashed up from the bow and swept across the bridge; the ship quivered, and then rose with a sickening sweep; up, and faster; she paused; and then dropped like a meteor into a yawning chasm; dropped like a thing gone mad. Head on into another mountain of water. The bridge was again swept with a drenching wave. Cold, foam-flecked water washed over the deck. The air was filled with chill, sticky spray that foreboded "weather" during the night.

"Pretty mean out," the Captain mused. "Barometer's dropping like it didn't know it had a bottom." He had addressed no one in particular, but the Pilot laughed.

"Don't worry, Captain," the Mate bantered, "there's a bottom to everything—even the ocean."

All afternoon and well into the evening, the Commodore checked his bearings on the radio direction finder. At 9:30 the storm broke with a fury approaching a typhoon. Rain poured down in solid sheets of water, twisted and lashed by the wind.

The telephone rang in the pilot house. The Commodore grabbed the receiver, listened, and then shouted the command to the Quartermaster: "Turn the searchlight on the loop aerial of the direction finder! It's broken! Nielssen calling!"

Then turning to the Mate: "The operator has to stay at the radio—anyone aboard who can repair that loop—right?"

The Mate remembered the sailor who had risked his life in Miami merely to prove his seamanship. "Aye, sir," he replied, then called the man up, curtly explained the trouble, and sent him out to do the job—right.

Under the glare of the Sperry light the seaman worked fast, efficiently. He seemed to be hardly aware of the raging elements. He had the wire. A quick splice and it was fastened to the insulator. He slipped to the deck below, and was swallowed in the darkness.

A moment later he reported in the pilot house: "Done, sir."

The Commodore smiled. "Good! We need that direction finder tonight. Better report in the galley for a bowl of Java."

Radio for Boatman, Motorist or Hiker

Practical Vacation Pointers

The author is a practical boatman and has installed radio on boats of all kinds. He is a practical radio man and has used radio on automobile trips. He tells just how it was done; just what to avoid

By W. F. Crosby

THE perpetual grouch, who goes around broadcasting the fact that radio is doomed for a terrific "bump" during the coming summer, is going to have a rude awakening, one of these fine mornings. He is going to wake up and find that radio has taken hold of the popular fancy more than ever and that radio and vacation are practically one and the same thing.

The forehanded radio fan is the fellow, who has made preparations far in advance, who has spent about half the winter in preparing and building a good set which he can take along with him on his vacation, or on his week end outings, whether they be on the water, by car, or just plain "hikes."

Such a man as this has had time to study the situation and the circuits and, by now, he is pretty well versed in what is what in the way of summertime radio; but there are always hundreds who have not looked so far ahead and it is to this class that this article should have its particular appeal.

Broadcasting seasons change, just as in any other industry, and the leading broadcasters are planning some fine things for the hot evenings. Dance music will predominate and what could be more enjoyable than to be anchored in some snug cove for the night with the old loud speaker pouring forth the strains of the latest dance hit. Or you might be tucked away in a tent, somewhere in the mountains, possibly during a rainy stretch. The morale of the whole camp will be brightened up if only a good radio receiving set is on hand, and, it might be added that good music, under such circumstances, sounds about twice as good as it ever did before, or will again.

Oh, yes, it is quite possible to make up small portable sets which can easily be transported on the back, and such little sets as this are frequently even more efficient than their larger brothers.

Consider the little UV-199 and what it makes possible. Here is a tube which draws such a small amount of energy from the "A" battery, that it is possible to run it from an ordinary flashlight cell! With such a set as this, employing several of these tubes, you will be able to have an outfit which will weigh next to nothing, when we stop to consider the more cumbersome batteries required with the six-volt tubes. Even the ordinary dry cell tubes, such as the WD-11 and WD-12, require larger and heavier batteries, for the simple reason that they draw a great deal more current from the "A" battery.

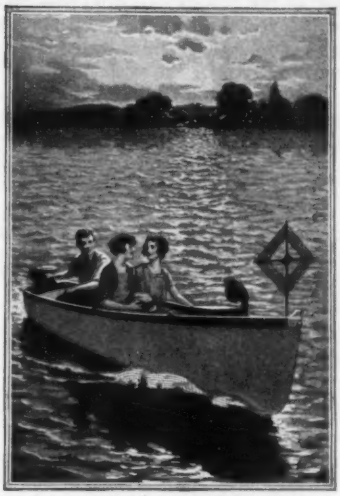
If you choose, you can make up a simple little one-tube set, using a 199, and the whole thing may be enclosed in a space considerably smaller than the average haversack. If you want to make use of what is known as a mercury condenser or a compression condenser in such a set as this, the total size of the panel need not exceed

An automobile trip will not be complete this summer without a radio set. Many a picnic lunch will be more enjoyable accompanied by radio music

six inches square, by possibly six or seven inches deep. There are plenty of simple circuits to choose from, but bear in mind that such a set will surely require an aerial. This will necessitate some form of reel or winding machine, where the wire may be kept when it is not in use. Such a simple thing as this will never feaze the average radio fan.

Then, if you wish, you may take advantage of radio frequency amplification, because the 199 tube is a mighty good radio frequency amplifier, and you may rig up a set which will contain several stages of untuned radio frequency. Of course there is no law against the use of tuned radio frequency, but it will make the set considerably more cumbersome and heavier. Some radio fans think that reflex circuits are the best for this kind of work, and if such a set is properly designed and built, it is quite possible, with three tubes, to make an outfit which will bring in broadcasting with sufficient volume for a small loud speaker. Such a receiver may be completely enclosed within a cabinet fifteen inches long, or even less, if you squeeze the parts up a little. The flashlight cells may still be used for the "A" battery.

In the reflex type of circuit, each vacuum tube is used over twice, once at radio frequency and again at audio frequency. Using a small loop aerial is a practical proposition, if the set is built right. Of course a regular aerial will give far better results, especially



Courtesy of Mullins Non-sinkable Steel Boat Co.
A suggestion for campers

on long distance stations, but if you happen to be camping within a fifty mile radius of some broadcasting station, you may rest assured that you will at least hear that station, and if circumstances are right, you may do even better.

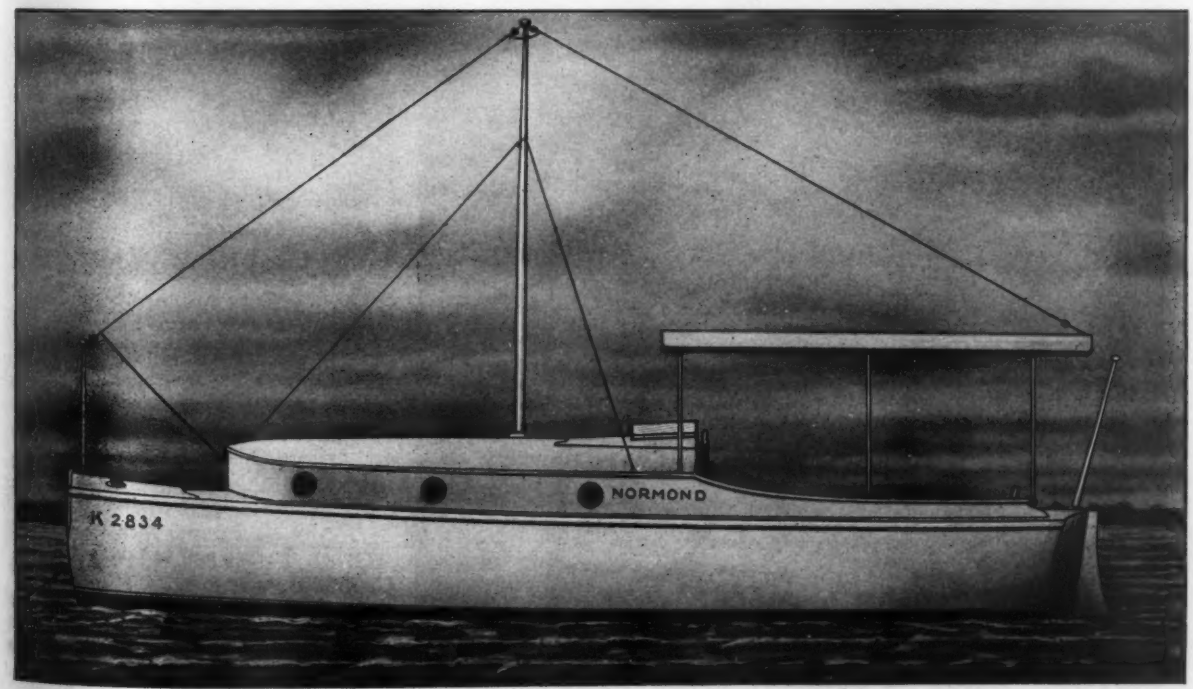
These little sets, of which there are many variations, will prove excellent for hiking and canoe trips, where space is small and the weight must be kept down, but when we come down to the motor boats, we find that the problem is considerably simpler. The main trouble seems to be in getting a suitable aerial, and possibly the accompanying sketch will give an idea of what can be done on a rather small cruiser of about thirty feet.

In this particular case, the aerial is started at the top of the awning, way in the stern, and it is carried up to the top of the mast and thence down to the bow, where the lead-in wire is taken off and run in through the forward end of the cabin. There are many variations of this, but for the particular type of boat shown, such a rig cannot be beaten. It will give the maximum over all length to the aerial, something which is quite essential for good reception.

If two wires are run in the same manner, it is advisable to use some form of spreader just as near the top of the mast as possible. By keeping the aerial high up in this manner, the overall length is slightly increased. Every inch counts, especially on small boats.

Again referring to the sketch of the boat, you will notice that we have a small insulator at the bow, two at the masthead and one at the top of the awning. The masthead rig is simply a bridle with an insulator on each end, through which the aerial wire is passed, and then hoisted up the mast by the regular halyard. Such a rig as this is easily taken down at any time.

Now as for the ground, when you are on board boat, you have plenty of that all about you, despite the fact



An excellent aerial system on a small yacht or for the larger motor boats

that it takes the form of water. The only thing that is necessary is to make some connection to that material. This is sometimes accomplished by fastening a wire to the engine at some convenient place, allowing the shaft and propeller to do the rest. This rig is sometimes satisfactory, but a far better way is to have a copper plate attached to the outside of the hull, below the water line. There is only one difficulty here, and that is with the electrolytic action between the fastenings of the hull and the copper plate.

A combination of the two metals in salt water will always make trouble unless well defined rules are followed. If your boat happens to be fastened with brass screws or copper nails, then it will be all right to attach a copper plate to the hull, but be sure to use copper tacks in doing this. On the other hand, if the boat happens to be fastened with galvanized iron nails, then it will be far better to use zinc in place of the copper plate. Galvanized tacks should be used to hold the plate in place. It is also not advisable to allow this kind of a plate to come too close to the bronze propeller and shaft, because you will find that the plate has been eaten completely away after a month or two in the water.

One more thing while on this subject: try to avoid the use of solder, especially soldering to copper or soldering a copper wire to a zinc plate. Such practice is extremely bad underwater workmanship and it will not be long before you have no connection at all.

Instead of this, fasten the wire in place by means of screws, or by punching holes in the plate before it is attached and then threading the wire back and forth through these holes until a solid contact is made.

As for the set itself, we have a wide variety to choose from. Of course the old fashioned regenerative outfit will work, after a fashion, and in some cases extremely well, but it is more or less of a gamble as to just how it will perform. You will probably get a much stronger signal by resorting to one of the newer circuits, tuned radio frequency, neutrodyne, super-heterodyne, or reflex. Size governs to some extent, when we realize that great space is not always available. Of course some of the larger motor boats and yachts will have plenty of room for the most elaborate set, but this is far from true on the smaller cruisers.

Most of the present day motor boats are equipped with electric lights and it is not a difficult matter to arrange some means of taking off a pair of wires from the storage battery. There is one point to look out for in this respect. This has to do with the voltage of the battery.

In a great many boats the system calls for twenty-four volts and of course this will never do for a six-volt vacuum tube. For this reason it will be far better to call in an experienced electrical man and have him arrange for a six-volt line. If you have a large storage battery and are not sure as to its correct voltage, count the vent caps. If there are three of them, then you may be pretty sure that the voltage is just six, because each cell in the battery will give two volts and since there are three vents, there must be three cells. If you happen to have a battery with more than three vents in it, then you had better have it checked up carefully.

The writer has seen some yacht installations where the radio set has been tucked away in a locker with the loud speaker arranged so that it can be plugged in at different positions on the boat, either inside the cabin or in the cockpit. This does not call for much radio knowledge and anyone who has been able to build a radio set can easily figure out such a scheme.

In one rather elaborate outfit, the receiver had been built into a bulkhead desk and was completely concealed when the desk was closed. The set in question consisted of an ordinary detector and two stage amplifier with a horn arranged in the corner of the cabin, way up under the deck beams where it would never get in the way of anyone's head.

Of course, the large yachts are nearly all equipped with radio sets at the present time, many of them carrying regular licensed operators. These operators frequently have life rather easy and many of them have rigged up broadcast receivers for the yacht owners. Such installations are, of course, outside the scope of this article.

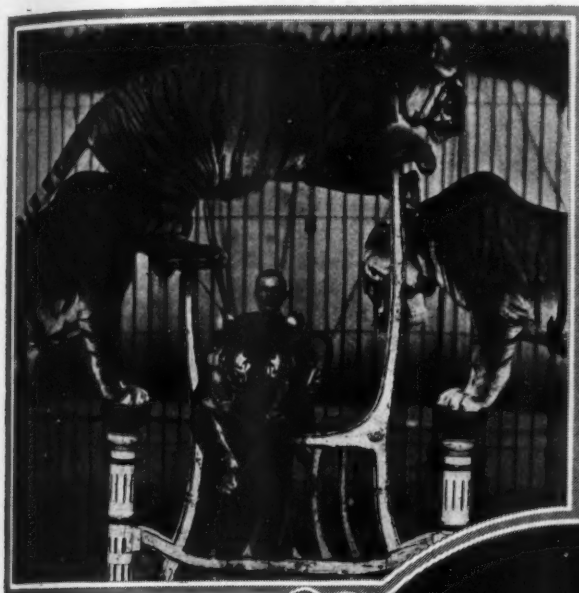
Easily the most popular sport today is automobiling, but radio is running it a close second and the day will come when the two will be combined to give the vacationist the time of his life.

Suppose you are about to start off on a trip to Niagara Falls, by automobile, of course, and you decide to take along a radio receiver. On the way you

(*Continued on page 75*)

On a hike, tie a rock on the end of flexible wire and throw it over the limb of a tree for an aerial

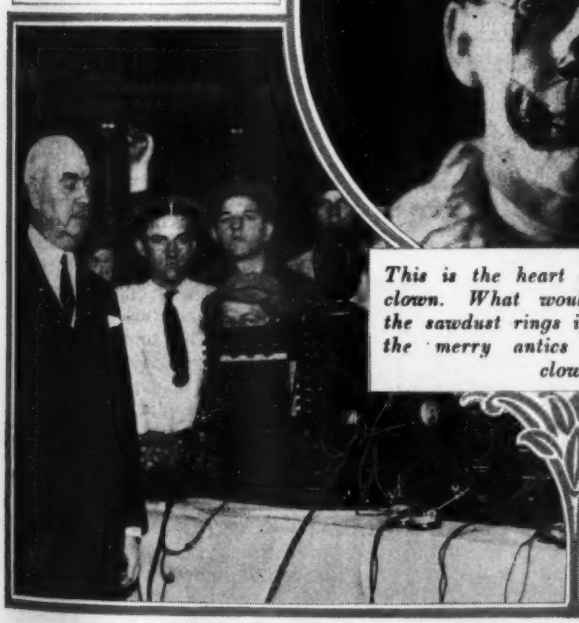
Ringling Bros. and Barnum & Bailey Broadcast



These tigers told the listeners-in on WJZ just what they thought about this sort of a "daily dozen." The lions also broadcast their ideas on circus life

The elephants had a lot to say. After they had broadcast, the seals and the bears, the laughing hyena and many other animals of the menagerie were allowed to broadcast

This is the heart of any circus—the clown. What would we care about the sawdust rings if we couldn't have the merry antics of the acrobatic clowns?



Lew Graham, the veteran circus announcer who introduced the various animals to the radio listeners. Lew is the "officiator" during the performances of the Ringling Bros. and Barnum & Bailey circus. Thousands know his "La-dee-es and Gen-tle-men," heard again over the radio.

The Pretty Lady of the circus parade. While WJZ broadcast the circus from New York, Sells-Floto circus in Chicago was broadcast from KYW. In both, everything from the bally-hoo of the side-show announcers down to the Calliope was included

Up Above the World—A Mile High—And Radio

The first recorded ascent of Mt. Marcy, or Tahawus as it was known to the Indians, was made in 1837 by Professor Emmons and his party. There were no trails or guide posts to aid them in their endeavors, and they struggled through the virgin forests and dense alpine growth of pure scrubby balsam. Today, however, one may motor to the foot of the mountain, and the climb may be made over no less than five well marked trails which converge at or near the mountain's peak. Trails are marked and shelters have been provided. Now, more than a life's span after Professor Emmons' ascent, climbers have taken radio to the top, and any vigorous, ambitious radio fan can do the same

This story of how two hikers got radio reception on the top of Mount Marcy is told by

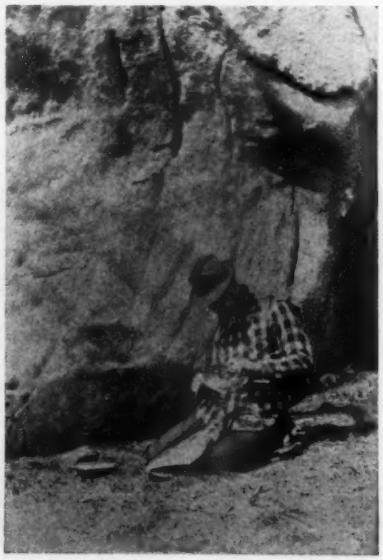
Hall E. Shepherd

Radio on Mount Marcy

THERE were two reasons which led Sherwood Marvin and the writer to climb Mount Marcy with a radio receiving set. The first and outstanding one was that it had never been done and thus by doing it successfully we could add a little to the short but brilliant history of radio communication. The second reason was that discoveries as to the effect of altitude and climatic conditions might be made on an antenna strung up over a mile above the mean sea level. In the former we were successful, but in the latter, due to unfavorable meteorological conditions, we did nothing. However, we successfully received a part of the programs of several broadcasting stations and so consider that the trip was a success.

Mount Marcy, or Tahawus, as it was known to the Indians, is the highest peak in New York State, rising to a height of 5,344 feet above sea level. Tahawus, or the Cloud Splitter of the Indians, was renamed after one of the leaders of the Empire State, Governor Marcy. The first recorded ascent was made by Professor Emmons in 1837, who climbed with great difficulty to the top through the virgin forests covering the lower slopes and the dense alpine growth of scrubby balsam near the top. When the first ascent was made eighty-six years ago it was a feat so difficult that the interest of the nation was aroused, but today, thanks to the work of the Conservation Commission of the State of New York, there are no less than five well defined trails, all plainly marked, leading to the top.

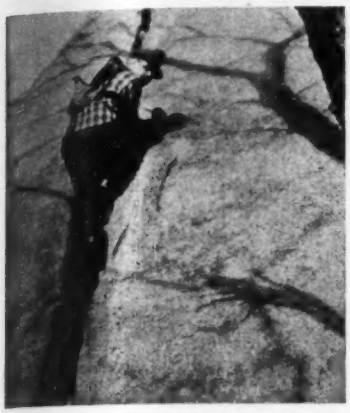
It had been the writer's intention to construct a single condenser Flewelling receiver, a receiver which had given splendid results at White Gate Farm, Madison, Conn., a few weeks before, on the trip to the peak of Mount Marcy, but after consulting a radio engineer who was with the Marine Corps for a year in the tropics, different plans were made in regard to the receiving set to be used. The conditions found on Mount Marcy were such that it would probably have been impossible to obtain any results whatever with the Flewelling because of its very critical grid-leak adjustment. The engineer told the writer of a very light and compact non-oscillating receiver which was a commercial product on the market and which he had tested and found to give excellent results. Thus a non-oscillating receiver was used, and such a receiver is highly recommended for the use of the camper and traveler in the wilds who desires to keep in touch with the events of the world without overloading himself with the heavy receivers now in general use.



Preparing for a test in reception at a difficult point

Now for the story of the actual ascent of Mount Marcy. Marvin and the writer left Doctors Island, located in Upper Saranac Lake, early one morning and went by boat to Bartlets Carry on the eastern shore of the lake. Packs were carried containing blankets, the necessary cooking equipment and the radio receiver already mentioned together with a hundred feet of stranded copper wire and the necessary "A" and "B" batteries. After going over the Carry we took the road and proceeded to Saranac Lake. From there we went to Lake Placid where we purchased a few supplies and then proceeded upon our way to Keene Valley Village. Many readers will remember from their school days the interesting stories by Warner of the country around Keene Valley. It was in this same district that he came so very near to being eaten by a bear. Neither of us saw a bear on the trip, although we did see several deer. From the main four corners in Keene Valley Village we took the Johns Brook Trail and headed for Marcy. This trail is the oldest and best known one from the east and was the one taken partly because of that fact, and partly because of the desire to see Keene Val-

ley. The distance to the top of Mount Marcy from Keene Valley Village is nine and one-fourth miles and the ascent 4,250 feet. After passing Bushners Falls we branched off and took



A precarious climb up the face of a rock cliff

the new trail from Johns Brook to Marcy through the notch south of Tabletop Mountain. This new trail was cut out by the Conservation Commission in 1920. We then proceeded up to a point just below the top of No Man's Mountain where we made camp for the night. The next morning we reached an intersection with the Van Hoevenburg Trail, which we took to the top of Mount Marcy. From this trail splendid views of the neighboring country were obtained.

Upon our arrival at the top the antenna was strung between two boulders on the very top of the mountain. Upon one of these boulders there is a map case erected in memory of a soldier who gave his life in the World War and one end of the hundred feet of stranded copper wire was attached to a leg of this case. For the other end a length of rope was passed around another boulder to which the antenna was attached. We had expected to have difficulty in finding an efficient ground, but found that moist soil went to the very peak of the mountain so that it was only necessary to drive down a spike. Upon checking with a compass we found that the antenna ran very nearly north and south. The lead-in was made from the southern end as there was more protection from the elements there. There was a very cold wind blowing and a driving rain fell at intervals during the day. Photographs were taken, but because of the poor light none were as good as we had hoped for. In none of them did the antenna show up, although we had hoped for a good one of the highest collector system in New York State.

In the evening the receiving set was put into operation and three broadcasting stations heard. More could probably have been logged, but it was very cold a mile up in the air and we desired to reach a valley in which to make camp for the night. The first station heard was WGY, located at Schenectady. It came in very clear and we were greatly encouraged. After getting this call the set was retuned and station WEAF, located in New York City, was heard. The next station was more difficult to reach, probably because several changes were made in the hook-up, and it was nearly a half hour before we found it to be WMAF at Dartmouth, Mass. Because it was getting late no attempt was made to receive the long wave stations as we had at first intended. We were very thankful that we had not used a regenerative receiver because, with the rain and wind, fine adjustment of the circuit would have been impossible.

On the return trip a much easier and shorter trail was used. It is known as the Van Hoevenburg Trail, the same that we intersected on the upward trip

Hanging Spear of East River Falls

at the top of No Man's Mountain, and runs to Adirondack Lodge where we found a road to North Elba. From there we went to Lake Placid and then back to Upper Saranac Lake over the same roads that we had used on the upward trip.

Although much better results might have been obtained had the climatic conditions been better, we were very well satisfied with the results obtained and were very glad to have had the opportunity of operating the first receiving set on Mount Marcy, the highest point in New York State.

The open camp at the foot of Colden

You will find

A Good Portable Receiver described on page 54

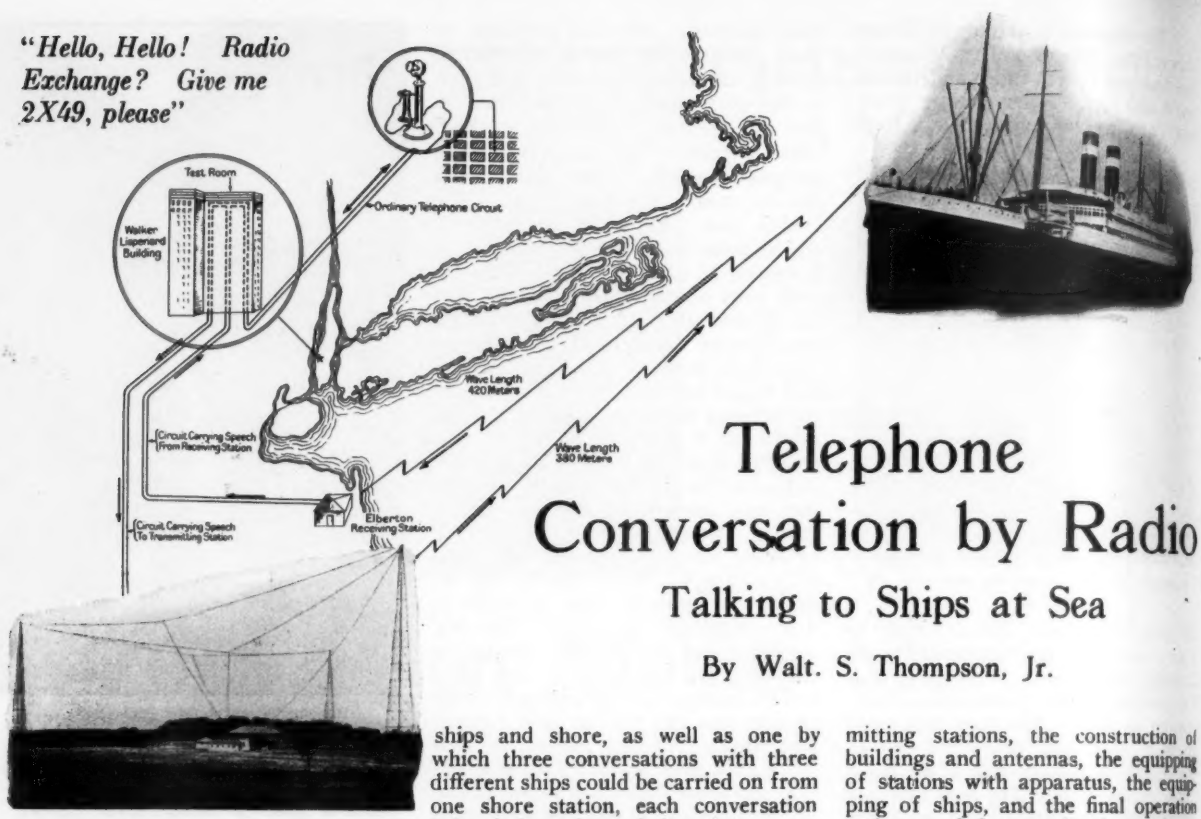
Make it and try Mount Marcy yourself!

Also,—if you are interested in Receivers—

Examine the new D-Coil Receiver

described by the designer on page 34

"Hello, Hello! Radio Exchange? Give me 2X49, please"



Telephone Conversation by Radio

Talking to Ships at Sea

By Walt. S. Thompson, Jr.

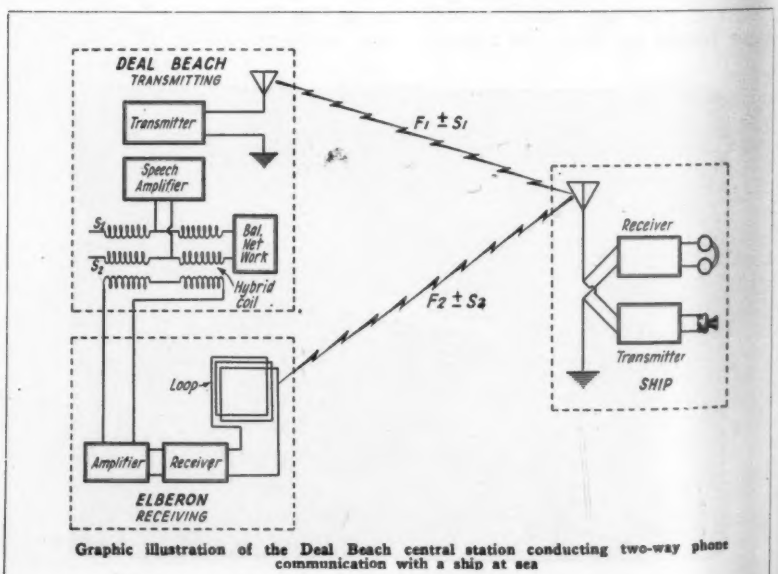
PROBABLY all the readers of this magazine are radio fans and have been enjoying the programs transmitted from the various broadcasting stations, but it is doubtful whether many of them have ever carried on a telephone conversation through the air. Although the possibility of ever using a radio system as a means for conversing with one's friends seems remote, such service will no doubt eventually be available to the majority of telephone subscribers, and will enable them to communicate by telephone with ships at sea. When this new telephone service goes into effect, the business man or any other telephone subscriber will be able to pick up his receiver and call a steamship just as he is now able to call some distant city. This service, however, will be limited to ships which are within a certain distance from shore.

It is the purpose of this article to describe very briefly the development of this radio system and to give the reader some idea of the apparatus used, as well as its operation.

This development began in 1919 when the engineers of the American Telephone and Telegraph Company and of the Western Electric Company started working on the problem of devising a means by which any telephone subscriber could talk with those on board ships at sea. This, of course, necessitated the development of a two-way radio telephone system between ships and shore, as well as one by which three conversations with three different ships could be carried on from one shore station, each conversation being independent of the other.

The engineers who designed this system were confronted with both technical and practical problems, a few of which may be mentioned as follows: The perfection of a two-way radio telephone apparatus to meet the above-mentioned requirements, the perfection of transmitting apparatus, the development of a selective receiving system which would allow the use of a narrow frequency band, the location of transmitting stations, the construction of buildings and antennas, the equipping of stations with apparatus, the equipping of ships, and the final operation and tests of the completed system.

In the completed system, two-way conversation was obtained by using different frequencies or wavelengths for sending and receiving. Because of the highly selective receiving circuits, only a small frequency difference between the two channels was necessary. In order that three conversations could be held simultaneously and independently, three separate transmitting sets and three separate antennas were used.



Graphic illustration of the Deal Beach central station conducting two-way phone communication with a ship at sea

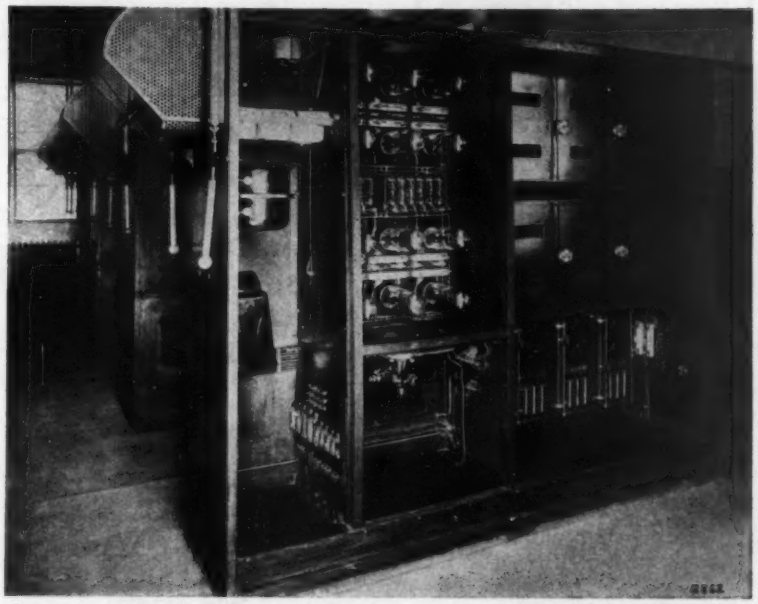
After the apparatus had been developed in the laboratory, a model transmitting system of low power was set up at Cliffwood, New Jersey. With this transmitting system and receiving sets located at a distance of about sixteen miles, a thorough operating test was made. This test showed that three conversations on carrier waves of 725, 750 and 775 kilocycles per second could be separated at the receiving end without any perceptible interference between them, and that interference from other continuous wave stations was negligible.

While these experiments were being carried on at Cliffwood, work was started on the permanent transmitting station at West Deal, New Jersey. The larger building shown in the picture is the permanent housing for the sets, and the smaller is used for experimental work. The three steel towers, each of which is 165 feet high, form an equilateral triangle, 500 feet to a side. Three steel cables join the tops of these towers, and three more extend inward and meet over the station. Four antennas are thus supported, one antenna going to the middle of each of the first mentioned cables and one rising vertically to the middle of the triangle.

The final system as installed at Deal Beach makes use of these four antennas and four transmitting sets, each

A transmitting unit such as installed on board ships

with a power output about equal to that of our larger broadcasting stations. One set and the vertical antenna are tuned to 600 meters for calling purposes and for emergencies. The four receiving sets with their loop antennas are located at the receiving station at Elberon, about a mile north of Deal Beach, and are connected to Deal Beach by a twenty-wire telephone cable.



One of the transmitting units. In this figure can be seen the various shielded compartments which contain the master oscillator and various amplifiers, six radio frequency power amplifier tubes, six modulator power tubes, a few choke coils, circuit breakers, etc.

The general principle of operation is indicated in the figure showing the ship station using only one antenna for both transmitting and receiving, although two different carrier frequencies are used. The dotted lines in this figure indicate the three stations, that is, one transmitter at Deal Beach, one receiver at Elberon, and one transmitter and receiver on the ship. It will be evident that the speech waves coming in from the left over the land wires will be amplified by the speech amplifier and will be impressed on the radiated radio frequency waves. The complete wave sent out by the transmitter is designated as $F_1 \pm S_1$ to indicate that the radio frequency wave with a frequency of F_1 has impressed upon it a speech frequency S_1. These waves are received at the ship which in turn sends out a radio wave designated as $F_2 \pm S_2$. This wave is picked up by the loop antenna at Elberon and is detected and amplified before it goes out on the telephone line to Deal Beach. At Deal Beach the received wave passes out over the telephone line without affecting the transmitter. The purpose of the hybrid coil and the balancing network is to prevent any received waves, coming from Elberon, from reaching the transmitter.

In an early future number will be published an interesting European development of a radio telephone service.

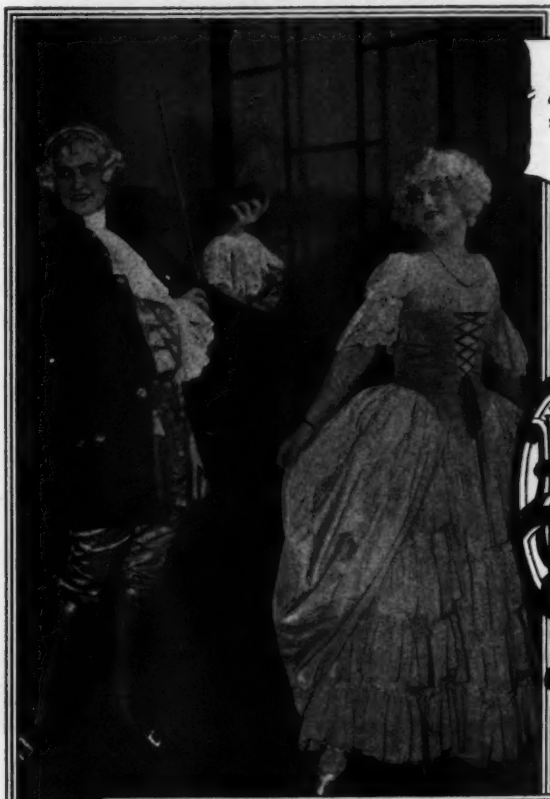
One operator seated at the switchboard has complete control over all the transmitting apparatus. The dials control amplification and, by means of jacks and cords, any New York long distance telephone circuit can be connected to any one of the four radio circuits.

In the final layout of the various stations, there are two operating shore stations, one at Deal Beach, New Jersey, and the other at Green Harbor, Massachusetts, and an experimental station at Cliffwood, New Jersey. The ships on which the stations were installed operate between Boston and Philadelphia or Baltimore. The diagrammatic picture shows how a connection is set up between one of these ships and a telephone subscriber. In the instance illustrated here the Deal Beach transmitting station and the Elberon receiving station are connected to New York by wire circuits, and are in communication with the steamship *America*.

Probably the most interesting experiment carried on with this apparatus was the instance in which a telephone conversation was carried on between the S. S. *Gloucester* in the Atlantic Ocean and an operator on Catalina Island in the Pacific. This circuit was made through two radio links, between the S. S. *Gloucester* and Green Harbor, Massachusetts, and between Long Beach, California, and Catalina Island, and one wire link between Green Harbor and Long Beach. The quality of transmission in this case was sufficient to enable the operators to understand each other perfectly.

"Vogues" Broadcast

The latest Shubert success, "Vogues," broadcast direct from the Shubert Theatre by WJZ, has excellent music, good comedy and fine dancing



Odette Myrtil and Irene Delroy in a whimsical number

Anna May Dennely in "Vogues"

Betty Compton in one of her dances

Jimmy Savo and Fred Allen, the "laugh manufacturers"

Selecting Loud Speakers

The right loud speaker is one that will reproduce perfectly for the broadcast listener the concert which is being given at some broadcast station studio

By Dr. Alfred N. Goldsmith
Fellow, I. R. E., Director of Research, Radio Corporation of America

TO compress an entire orchestra into a tiny circular sheet —this is the audacious demand of the modern radio engineer when he insists that the loud speaker shall reproduce perfectly for the broadcast listener the concert which is being given at some broadcast station studio. The problem is really a comparatively recent one. While telephone receivers have been known for fifty years, they were generally adapted only to reproduce the voice feebly and with fair accuracy at best. It was necessary to press them to the ear to understand at all well, and they failed to reproduce music with any reasonable degree of satisfaction. If it was attempted to make loud speakers of them, they rattled and distorted the music badly. A new electric and acoustic technique has had to be developed to meet the requirements of an effective loud speaker. Only after considerable research and development has it become possible to produce such devices which will accurately follow their vocal masters at the broadcast studio.

A little consideration will indicate why the construction of a satisfactory loud speaker is so difficult. It must faithfully reproduce all sounds from frequencies as low as fifty vibrations or cycles per second—corresponding to the deepest tones of the organ and piano—to frequencies as high as eight or ten thousand cycles per second—corresponding to the highest overtones of the violin or piccolo and certain of the overtones of the spoken consonants "s" and "f." It must be capable of producing soft pure notes and also extremely loud notes, so that the expression and meaning of musical compositions or oratorical efforts shall not be lost. It must accurately reproduce, in correct proportion, the voice and its piano accompaniment, or the various instruments which blend into an orchestral ensemble. And, when finally produced, it must be a sightly or even ornamental article since its place is generally in the home.

Great care is taken at high-grade broadcasting stations to insure accuracy of quality in the concerts sent out from such stations. In fact, a great deal of the distortion imputed by some listeners to the station is really due to their unsuitable loud speakers. The experience is often repeated of listening to an exquisitely rendered concert from a definite station on one receiving set, only to be amazed at its poor quality on a nearby receiving set. It is for this reason that the listener should suspend judgment on the quality of a concert until he has proven beyond doubt that his receiving set is correctly designed and used, and that his loud speaker is a good example of a reliable product.

Loud speakers in general include a strong magnet, which is either a permanent steel magnet or, in a few cases, an electrically-excited magnet, which requires battery current for its functioning. There is also a coil of wire, generally wound over the permanent magnets, through which flow the electric currents, which carry the music in the form of regular or irregular fluctuations of these currents. In some loud speakers, an iron diaphragm is set into motion by the variation of magnetism caused by the incoming electrical currents carrying the music. In others, diaphragms of mica or other materials are set into motion by mechanical systems attached to them, which, in turn, are controlled by the varying magnetic pulls on a steel or iron movable part of the system. The exact arrangement of the loud speaker is therefore not yet standardized, but what is required from the loud speaker is well-known to the experts; and elaborate electro-acoustic laboratories have been established by the leading radio companies for the continued development and improvement of the device.

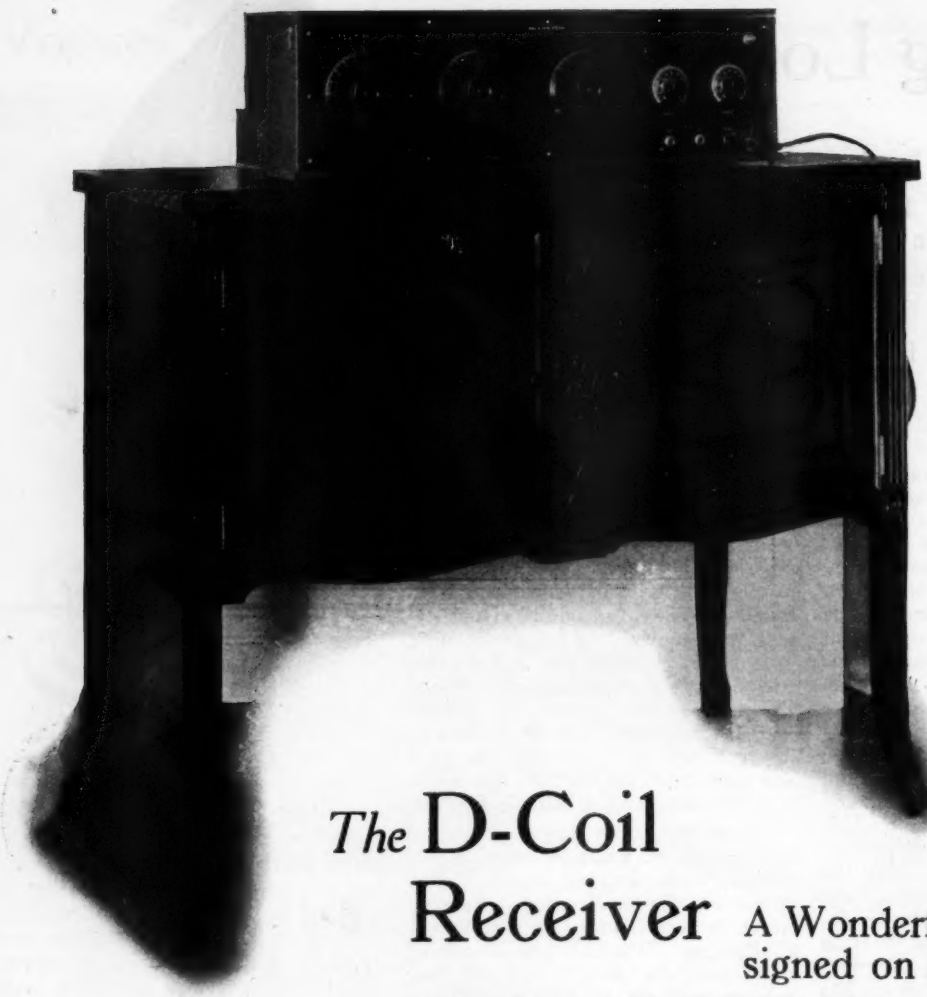
Practically all loud speakers are provided with a horn of wood, fiber, papier-mâché, or some other material which is believed to be suitable. A great deal of the quality and sensitiveness of the loud speaker depends on the materials, shape, and mode of attachment of the horn. As a general rule, short horns emphasize the higher pitched notes. However, so much depends on the angle of the horn opening and on its method of attachment, together with the characteristics of the telephone receiver portion of the loud speaker, that no general statements can be here given as guides to what constitutes a suitable horn.

In the development of the new Radiola loud speakers which have been designed as the result of much systematic laboratory experimentation literally thousands of accurate measurements have been made to avoid the common faults of most loud speakers. Unfortunately the testing procedure and laboratory arrangements are too technical and complicated to be described here, but they represent a most interesting modern development in the field of sound reproduction.

The principal faults of some loud speakers, and the general listening tests for them are:

1. The loud speaker fails to reproduce high pitched notes, but does respond to low pitched notes. Such loud speakers will sound well on piano pieces in the lower register, and on bass voices. Tenors and sopranos will sound thin and weak, and the violin will lack piquant quality, being "flattened out" into flute quality. Speech, and particularly feminine speech, will not be fully intelligible. Orchestral

(*Continued on page 63*)



The D-Coil receiver is seen resting on the top of a console victrola. The output of the receiver is connected to a phonograph attachment which is attached to the victrola. The panel of the receiver is mahogany colored and all the dials are of the same color. The cabinet has a veneer of dark brown leather over the wood and since the victrola is mahogany, the whole setting blends in very nicely

The D-Coil Receiver

A Wonderful Circuit—Designed on a New Principle

A New Type of Transformer Provides a Stable Non-Oscillating Radio Frequency Amplifier—Covers a Wide Range of Wavelengths—Outdoor or Indoor or No Antenna—Easy to Construct—Simple to Tune

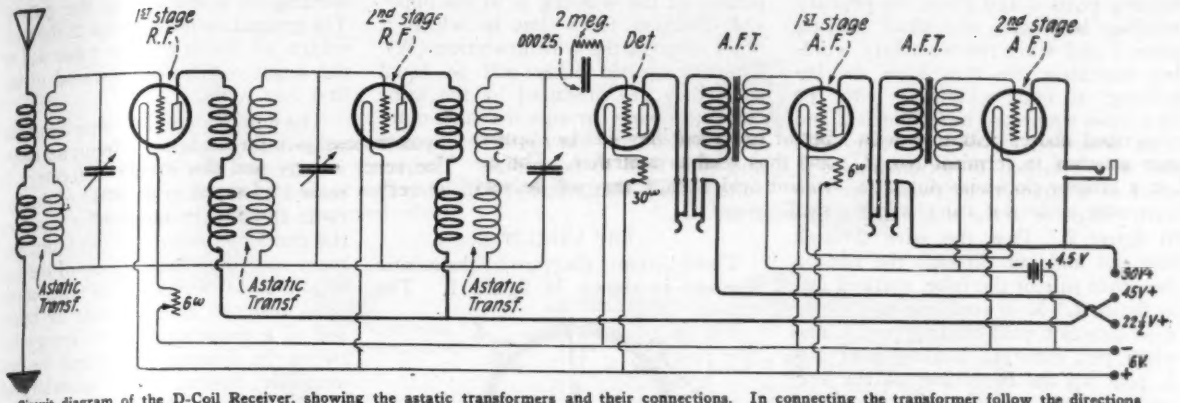
By K. M. MacIlvain

THE limitation in a radio receiving set employing several stages of radio frequency amplification is that the tubes in the radio frequency stages tend to oscillate due to the back coupling in the different radio-frequency circuits. The greater the number of tubes used for radio-frequency amplification the greater is the tendency for these tubes to oscillate and there is a definite limit to the number of tubes that may be used in any of the standard circuits published up to date.

The following is the description of the construction of a receiver that uses special coils or transformers in the radio-frequency circuits which so stabilize the circuits that, using the number of tubes shown in the accompanying circuit diagram, there is not the slightest tendency for self oscillations, and therefore the maximum amplification possible with the number of tubes shown can be obtained, as each radio-frequency circuit may be tuned right on the peak of the incoming wave without the usual howling and subsequent loss of intensity experienced in the majority of radio-frequency amplifying circuits. Many circuits employ a resistance in the circuit to damp out the oscillations and the loss thus introduced is probably so great that it would be possible to cut out one tube to eliminate the damping resistance and still get the same volume in the output circuit.

The neutrodyne receiver uses neutralizing condensers to balance out the back coupling, due to the capacity feed back in the elements of the tubes. But this does not neutralize the feed back due to the coupling between the inductance coils in the different circuits, and many B. C. L.'s who have constructed their own neutrodyne receivers find it exceedingly difficult to neutralize their sets properly, due to the fact that these neutralizing condensers will not balance out the feed back due to the coupling between the coils. The radio experts say that the coils in the neutrodyne receiver when placed at just the right angle may be got into a small space and at the same time have zero coupling. That angle is a critical angle and for the amateur building his own receiver it is a mighty hard one to find.

The D-Coil or astatic receiver is an advance over most modern circuits, as it employs no neutralizing condensers and no damping resistance, and principally it is better because the radio-frequency amplification can be carried to a higher degree. In other words, more stages of radio-frequency amplification can be used and consequently greater distance and more volume may be obtained. This seems perfectly reasonable to expect, since there is no tendency to oscillate with the number of tubes used in the circuit that is herein described. The amplification can be carried along further to a point where oscillations



Circuit diagram of the D-Coil Receiver, showing the astatic transformers and their connections. In connecting the transformer follow the directions carefully as given in the text. Reversing one connection will render the set inoperative

will commence and when this point is reached, some neutralizing unit may be employed and the amplification carried still further.

The heart of the astatic receiver circuit is in the radio-frequency transformers which are wound in a special manner so that the magnetic field around them is neutralized and there is therefore no coupling from one coil to another. Due to the fact that these transformers have a neutralized field they may be located in the receiver assembly in a vertical position, and it is not necessary to spend a lot of time in setting them at some critical angle as is necessary with the coils or neutroformers used at the present time in the standard circuits. There will be zero coupling between these transformers when aligned in a vertical position. In the test circuit which the author built these coils were set a distance apart just great enough to mount a tube socket between them. Since these coils are the heart of the circuit it is essential, at this point, that their construction be described in detail.

CONSTRUCTION OF TRANSFORMERS

First, procure three pieces of bakelite tubing, three inches long and three inches in diameter. With a hack saw, cut a ¼-inch slot down the side of each tube, starting at one end and cutting to within ¾ of an inch of the other end. Also, on each tube, cut a similar slot on the opposite side, diametrically opposite as shown in the diagrams. Obviously, it wouldn't be advisable to cut straight through from one end to the other as the tubing would then be in two sections, therefore the ¾-inch spacing is left at one end to make the tube self-supporting. The windings consist of a primary and a secondary wound with No. 24 double cotton-covered copper wire. There are 10 turns in the primary winding and 40 turns in the secondary. Four binding posts for the terminal connections to the two windings are mounted at one end of the tube as shown in figures 2 and 3. Two for the primary winding are mounted at the bottom of section (A) and two for the secondary at the bottom of section (B). For the purpose of discussion these are numbered 1, 2, 3 and 4, respectively. Good serviceable binding posts may be made from ⅝-inch 8/32 round head brass machine screws with nuts and washers to fit.

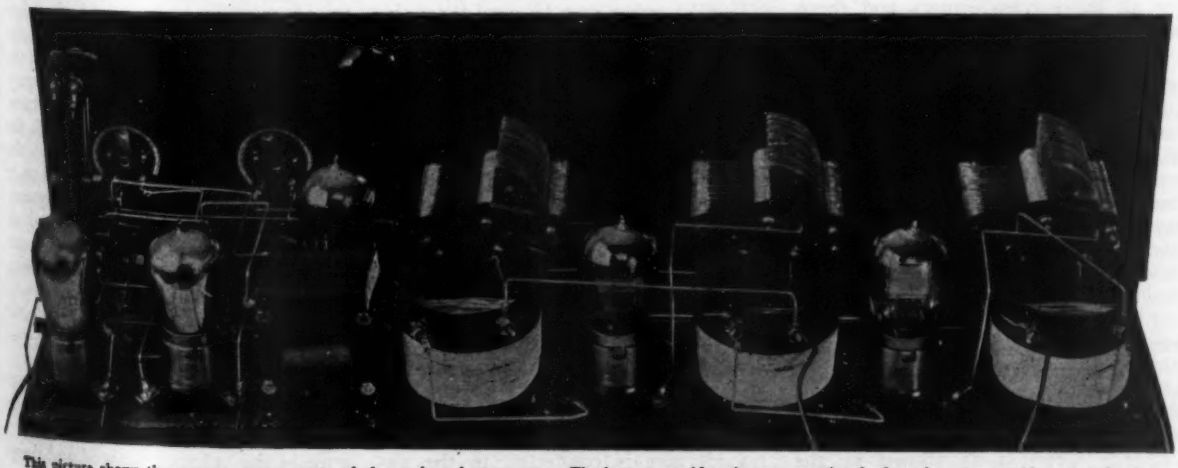
Now start the winding. Cut off a piece of No. 24 D. C. C. wire about 14 feet long. This will be long enough for the primary winding with a good surplus for connections to the binding posts. Connect one end of this wire to the binding post marked No. 2 in figure (2), and connect the end of the wire left on the spool to the binding post marked No. 3 in the figure. Since

LIST OF PARTS

One 7"x26" Box
One 7"x26" Radion Panel
One 7"x25" Base board
Five Paragon sockets
One 30-ohm rheostat
Two 6-ohm rheostats
Three 43-plate Cardwell condensers
Two Acme audio frequency transformers
Three pieces of bakelite tubing 3" long
One filament switch
Three 4" dials

ACCESSORIES

Five UV-201A tubes
One 6-volt, 100-amp. hr. storage battery
Four 22½-volt batteries
One loud speaker
One plug
One pair of phones
One aerial with accessories



This picture shows the proper arrangements of the various instruments. The layout provides short connecting leads and easy assembly. A 4½-volt "C" battery is shown on top of the first audio frequency transformer (from right to left)

binding posts 1 and 2 are the primary winding terminals, and since binding posts 3 and 4 are the secondary winding terminals, we thus have the beginning of both windings, with the two wires connected to terminals 2 and 3 as described above. Starting with the wire attached to terminal No. 2, wind in a counter-clockwise direction until you come to the slot, marked (x) in figure 2. Pass the wire through this slot and out through the slot on the other side of the tube, marked (y) in figure 2. Now continue in a clockwise direction past binding post 4, and when you come to binding post No. 3, pick up the beginning of the secondary winding and wind it in parallel with the primary winding, both wires side by side. Continue the double winding until you come to the slot (x), pass the wires through this side and out the other side at (y), proceeding with the winding in a counter-clockwise direction on this side. When ten turns have been wound on, drill a small hole in the tube at the tenth turn and in line with binding post No. 1. Pass the end of the wire being used for the primary winding through this hole and connect it to binding post No. 1.

One complete turn, starting at terminal No. 2, for instance, is traced in a counter-clockwise direction to slot (x), through the center of the tube and out at slot (y), in a clockwise direction past terminals 4 and 3, through the slot at (x), out at (y) and in a counter-clockwise direction back to the starting point. The primary winding having been thus completed, continue on with the secondary winding until 40 turns have been wound on. Drill a small hole in the tube at the 40th turn and in line with binding post No. 4 and connect the end of the secondary winding to this terminal. One astatic transformer is thus completed and two more are wound in a similar fashion. Two hundred feet of No. 24 double cotton-covered copper wire will be enough for all three transformers and there will be a surplus.

Just a few lines to explain why these transformers are so efficient in the circuit in which they are used. The following theory will explain why they have a neutralized field and thus afford no chance for back coupling between the coils. Looking at figure 4 and assuming a current flowing in the secondary winding due to signal current flowing in the primary, as the current flows through that section of the winding marked (A) it will produce a magnetic field which will be in the direction as shown by the line and arrows on that side. The same current flowing through the section marked (B) will set up a magnetic field in the opposite direction as shown by the arrows, since the current through this section of the winding is in the opposite direction from that in which it flows through the wire in section (A). These magnetic fields will be equal since they are produced by the same current flowing through the same number of turns and they will be opposite and thus tend to neutralize. The resultant field, then, if any, will be very small.

THE CIRCUIT

The schematic diagram of the astatic receiver is shown in figure 1. The

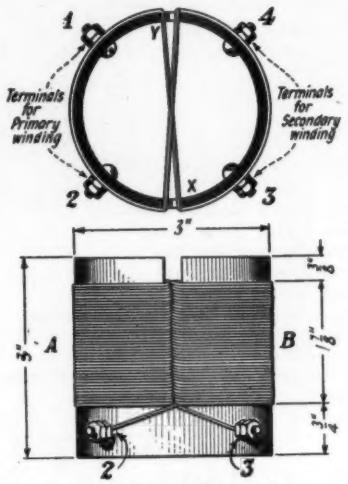


Figure 2

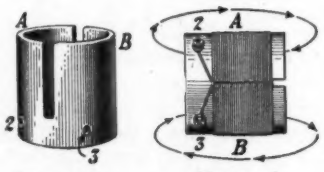


Figure 3 Figure 4

These sketches illustrate the method of winding the D-coils described in the text

first two tubes are radio-frequency amplifiers, the third is the detector and the last two are the audio amplifiers. UV-201A tubes may be used throughout, or they may be used only for amplifiers and a UV-200 tube used as a detector. The filaments of the radio-frequency amplifiers are controlled by means of the 6-ohm rheostat shown in the figure and connected as shown. Six ohms is sufficient to control these two tubes connected in parallel. The detector tube is controlled by a single rheostat and if a UV-200 is used for a detector the resistance of this rheostat should be 6 ohms, but if a UV-201A is used this should be a 30-ohm rheostat. The two audio amplifiers are controlled by the single 6-ohm rheostat shown in the figure. The antenna circuit is untuned. One terminal of the primary winding of the first astatic transformer is connected to the antenna and the other terminal of this winding is connected to the ground. The ground is tied through to the grid-return of the first three tubes and to the negative filament terminal of the first two tubes.

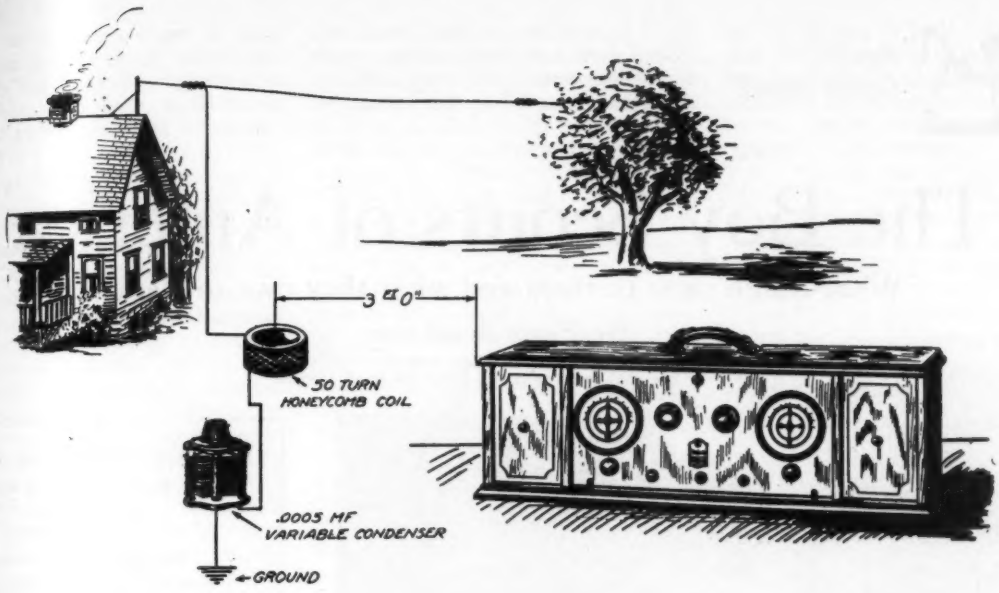
The antenna circuit simply functions as an untuned pick-up circuit for radio-frequency energy and this energy is passed on to the grid circuit of the first radio-frequency amplifier by means of the coupling between the 10-turn primary and 40-turn secondary of the first astatic transformer. The transformer is so designed as to provide the transfer of a great amount of energy between the antenna circuit and the first amplifier circuit. The secondary of this transformer is tuned by means of the 43-plate variable condenser connected directly across the terminals of this winding. A variation of this condenser from minimum to maximum tunes in stations between 100 meters and 650 meters in wavelength. Thus everything from amateurs, through the broadcast range and up to the commercial ship and shore stations can be tuned in on this combination.

The plate of the first radio-frequency amplifier tube is connected to the 45-volt tap of the "B" battery through the primary winding of the second astatic transformer. The secondary of this transformer is tuned in the same way as the first and the amplified energy applied to the grid of the second tube. The plate circuit of the second amplifier tube is a duplicate of the first. The secondary of the third astatic transformer is in the detector circuit and is tuned in a similar manner to the first two and the energy applied to the grid of the detector tube through a .00025 mfd. condenser and a 2-megohm grid leak.

There is a double circuit jack in the plate circuit of the detector tube which is wired up as shown in figure 1. If the phones are plugged in here, the circuit to both sides of the primary winding of the first audio frequency transformer is opened and the plate circuit of the detector tube is completed through the phones. When the phone plug is removed, the primary winding of the audio frequency transformer is connected in series with the plate instead of the phones and the audio frequency energy is passed on to the grid of the first audio frequency amplifying tube. The plate circuit of this tube is a duplicate of the detector tube plate circuit with the exception that it is tied on to the 90-volt tap of the "B" battery, whereas he detector tube plate was tied on to the 22½-volt tap.

If a 201A tube is used as a detector the plate voltage may be increased to 40 volts, although there is little difference in the volume obtained and there-

(Continued on page 74)



Increasing the Range of Your Super-Heterodyne

By William J. Smith

THAT type of Radiola Super-Heterodyne which is equipped with a small self-contained loop provides a greater range of reception than any type of radio receiver which the writer has ever witnessed in operation with a loop of such small dimensions. In the Eastern part of the United States one is enabled with this compact outfit often to secure loud speaker operation from stations as far West as Denver, Colo., and further.

By the use of an enlarged external loop, consisting of fifteen turns of wire spaced three-quarters of an inch apart and wound on a rectangular frame (14½ inches in width, 10½ inches in depth and 25 inches in height), it was easily possible to obtain loud speaker operation from the Pacific Coast with quite some regularity, even when a local broadcasting station only three-quarters of a mile away was in operation, and with a difference in wave-length of only 9 meters.

In event that the owner of one of these splendid equipments is not in a position to construct a loop of the dimensions which I have set down above, the receiving range of the semi-portable Super-Heterodyne can be materially increased by the method shown in Figure 1, where a small honeycomb coil of approximately fifty turns and a variable condenser are connected in series with the usual type of aerial. When the honeycomb coil is placed parallel with the loop inside of the Super-Heterodyne box, and the antenna, as well as the Super-Heterodyne set, are tuned to resonance with one another and to the frequency of the incoming signal, then a marked increase in signals will result; in fact, so much so that it is usually necessary to decrease the sensitiveness of the Super-Heterodyne for quieter operation. It will be found that an increase in signals can be obtained even though the honeycomb coil is three or four feet distant from the loop of the Super set.

In general, the process of tuning which I usually employ is the following. Distant stations are first logged on the Super-Heterodyne set in the usual way but using the loud speaker. The station desired is picked up on the Super set, being tuned to resonance on the two tuning dials in the ordinary manner. Then the antenna is tuned to resonance with the Super set by means of a small variable condenser, and when resonance is located, a very marked increase in the loud speaker volume will result. I recommend this connection to those who have not had the opportunity to construct a larger loop for the Super-Heterodyne receiver.

I have not yet found it necessary to use a headphone with the Super-Heterodyne set to locate a far distant station, as the sensitiveness of this receiver is such that it will invariably operate the loud speaker satisfactorily.

Boys!
Gather 'round!

The Boy Scouts of America

What Radio owes to them and what they owe to Radio

By Pierre Boucheron

A pioneer in the Radio Industry
Tells how the Boy Scouts and Radio hit it off together

Members of the Boy Scouts of America made tests for "dead areas" in Central Park with a portable radio set, and acquired useful data for future experimenting

IT is a long way back to those days of Greece, in which the romantic figure of the Marathon runner was the sole means of communication between the cities of this early democracy.

The classic story of the runner Phidipides, who bore the news of the Greek victory of Marathon for a distance of some twenty odd miles, then to drop dead from sheer exhaustion, is a story that stimulates boys and men alike to an appreciation of the unswerving purpose and tenacity of this man to perform the task given him though it cost him his life.

Great strides have been made in the science of communication since that time. Today the boys of our Nation are spared from such undertakings, for electricity has become the standard message bearer the world over. First, science gave to mankind the telegraph, then the telephone, and now radio is ready to serve every man, woman and child.

Radio enjoys the distinction, perhaps as no other art, of being especially a boy's and young man's game. As a matter of fact, the great progress that radio has made during the past five years can be directly attributed to the imagination and energy of boys, who began to experiment with radio shortly after Marconi's first successful tests back in 1920.

It was the after-school experimentations of Edwin H. Armstrong that gave to radio that famous device we call the regenerative circuit—a circuit that jointly with the vacuum tube has done more to bring the broadcasting art to its present state of usefulness than any other single invention.

Of the men who are leaders in radio today, whether in the long distance radio telegraph, marine or broadcasting fields, there is hardly one who did not start his career as a boy experimenter between the ages of 14 and 19.

Today there are in round numbers about 500,000 Boy Scouts in America. Probably three out of every four Boy Scouts has made or owns a radio set. With such a display of intense interest in the art, the future has surely many wonderful inventions and developments in store for us. With thousands of boys experimenting, playing and studying radio,—growing up with the

BOYHOOD LEADS TO RADIO

The Beginning of a Career

As told specially for Boy Scouts

By Pierre Boucheron

I will tell you how I entered the radio profession.

First I learned the American Morse code jointly with a boy friend back in 1906. We strung a wire between our houses about two city blocks apart, then we made our own telegraph instruments, winding the electro magneto by hand. The line was the closed circuit method and worked quite well with bluestone batteries. Every morning and night we "spoke" to each other for a brief spell by means of dots and dashes. In three months we were proficient enough in telegraphy to be able to converse quite clearly and rapidly and three months later reached the speed of 25 words a minute. Frequently we spent some of our spare moments with the agent and operator of the nearby railroad station who permitted us to occasionally send and receive a real telegraph message over the regular railway telegraph circuit. Later I obtained a summer job in a telegraph office during the school vacation period. I don't recall ever having spent a more enjoyable vacation while at the same time earning money which came in good stead when school started again in the Fall.

Then in 1907 came radio amateurism. There were about seven amateurs in New York City then. How proud I was to be one of them!

In August, 1912, I sailed away on a big freight ship as wireless operator and in the succeeding four years I saw every important part of the world. But best of all was the experience that thousands of others like myself obtained out of the War by enlisting as wireless operator in either the Army or Navy.

business, as it were,—there is now building up a reserve of talent that will make our present prophecies of radio movies, radio vision, radio transmission of power, etc., pale into insignificant child's play.

Radio, of course, is not the special plaything of any set or group of boys. In point of cost it is easily within the reach of every wide-awake boy in the country. A resourceful boy of 14 tells me he has built himself a complete crystal receiving set at a total cost of one dollar. Another boy of sixteen with more well-to-do parents has bought himself a complete vacuum tube receiver at a cost of $100. I feel quite certain that the fun and fascination these two boys enjoyed has been the same in each case.

Although radio is within the reach of every boy, it is particularly accessible to Boy Scouts because of the splendid organization behind them.

Every Boy Scout should learn radio principles; should experiment and tinker with electricity, and should learn the telegraph code. Many of America's successful men started their careers as telegraphers; among them Andrew Carnegie, Thomas A. Edison, Frank Munsey, General J. G. Harbord and David Sarnoff. Something like 75 per cent. of all railroad presidents were at one time telegraph operators.

Boy Scouts should learn the telegraphic code for two prime reasons, which are as follows:

First, because this knowledge and ability will make one a better Scout, of greater use to his troop, and if a certain proficiency is attained, will qualify him for the Scout Radio Merit Badge.

Second, it will train the ear to an unusual degree of alertness and this newly acquired ability may later become a stepping stone to a future profession either in telegraphy, radio or cable operation.

In Scout work there is a great deal of fun to be had in signaling when several in each troop are sufficiently speedy in sending and receiving telegraphic messages; say from ten words a minute and upward. The apparatus is simple and may consist of two spark coil transmitters, two one-tube portable receivers and two portable aerials in the inexpensive form of two coils of copper wires. Two units of the troop can then separate by distances of from one-quarter mile to one mile, and then exchange messages. All transmitting apparatus of this nature must be licensed by the Department of Commerce.

Learning the telegraph code is not very difficult. First you memorize the alphabet consisting of dots and dashes. There are two codes used today: the American Morse Code, for land line wire work such as commercial telegraphy, railroad, news and stock broker communication; the Continental Morse for cable and radio communication. While it is advisable to become adept in the use of both codes. I recommend learning the Continental Morse Code, as this is the code used exclusively in radio work. One should first memorize the dots and dashes of the Continental Code so each character can be ticked off with a pencil or coin on a table or other hard surface. It takes on an average an hour to memorize the characters. It is much easier to attain speed in sending the code than it is to receive it. The latter requires consistent application for several weeks. A scout who determines to learn the code should get together with a nearby friend and practice each day for at least an hour. After a short time he will be able to understand the now meaningless dots and dashes, especially the messages exchanged between amateur stations that usually operate on 200 meters.

And now we come to what this ability may lead to. When a Scout is older and has left school, he can take up any one of a number of well-paid professions that require proficiency in sending and receiving telegraph messages. A few of these positions, as they occur to me, are: (*Continued on page 75*)

Boy scouts all over the country use radio. The upper picture shows a Boy Scout troop introducing the mysteries of radio to Seminole Indians near Miami, Florida. Just below a Scout of Queens Council in his tent in Camp Matinecock at Bear Mountain is seen tuning in the New York City stations Here to the left a Boy Scout of Waxahachie, Texas, is proudly exhibiting the set which he has installed in camp.

The Scout with the overseas cap is enjoying his radio set in Camp Wayne, in Ohio

Radio in the Canadian Wilderness

Our adventures over the portages and down the crest of White Water

By Sinclair Arthur

DR. HOBART and I decided to take our vacation in the Canadian wilderness. The idea appealed to us. The wilderness, where men imagine they are men.

We did think enough of our tame civilization, however, to include a good, portable radio set in our equipment.

On the way up to Chicoutimi we learned that a trip into the interior of Labrador, entailed something of an exact science; namely, the science of economy. Our kindly adviser—who, by the way, happened to be the mayor of Chicoutimi—told us that one simply doesn't carry excess baggage. He explained in detail:

A canoe, of course, would be necessary since travel of any extent during the summer months could only be effected by water. One blanket for each individual would be required. Clothing should consist of no more than light felt boots, khaki trousers, heavy flannel shirt, felt hat and heavy underwear.

A rain coat would be superfluous since one would undoubtedly perspire enough to warrant a soaking now and then.

A pot for tea and a pan for the foods would suffice as cooking utensils.

A tent for the guides and a tent for us would serve as shelter. One gun, a hatchet and a heavy jack-knife would complete the essentials.

"Of course," the mayor concluded as he shrugged his shoulders, "you will probably carry liquid refreshments, but you'll regret it on the portages."

Our guides, a French-Canadian and an Indian, protested vigorously when they learned that we contemplated the inclusion of our radio in the equipment. It was certainly apparent that every ounce would count.

We had a thirty-five-mile drive north of Chicoutimi to the head of Clear Lake. Most of the road consisted of logs laid cross-wise in the trail. Large holes and occasional stumps marked the course. The French-Canadian, Jacques, demonstrated his skill as a chauffeur by trying to leap over most of the pits and jump over the tree stumps and rocks.

Our guides. The Indian, Joe, on the left, the French-Canadian, Jacques, on the right

The supplies and equipment were loaded in the canoe. Doc and I sat in the middle, and the Indian, Joe, kneeled in the prow. Jacques occupied the stern.

Everybody in the camp came down to the shore to wish us luck—and lots of it. Jacques gave the word, and with that, he and Joe swung the canoe out into the water with short, powerful strokes. All woodsmen in Canada are proud of their paddling skill, and their strength. Jacques and Joe put their soul into that exhibition. Away out into the lake they paddled, never faltering, never relaxing a stroke.

Across the lake and down the Shipshaw we glided. The immenseness of country seemed to enfold us, gently at first, then seeming to close behind us, and finally we could feel the pull of the North. We could almost sense the fear that all natives of that wilderness learn to know at an early age.

Every family out in that vast wilderness has lost a friend or relative who has strayed too far from the trails—and never come back. The little villages are clearings. Not a tree within the forest line. The people are afraid of the forest. They do not want trees in their yards, in the streets, or in the town.

Doc suggested that we get out the radio.

"Be yourself, Doc," I chided. "Jacques made us leave the set in Chicoutimi."

But Dr. Hobart had been a professional man for a long time. "These Canadians," he replied, "have reconciled themselves to the idea of visitors from the States coming here to enjoy the freedom of the trails, and incidentally, to escape from a remarkable amendment in the Constitution—the eighteenth, I believe."

"Yes?" I encouraged.

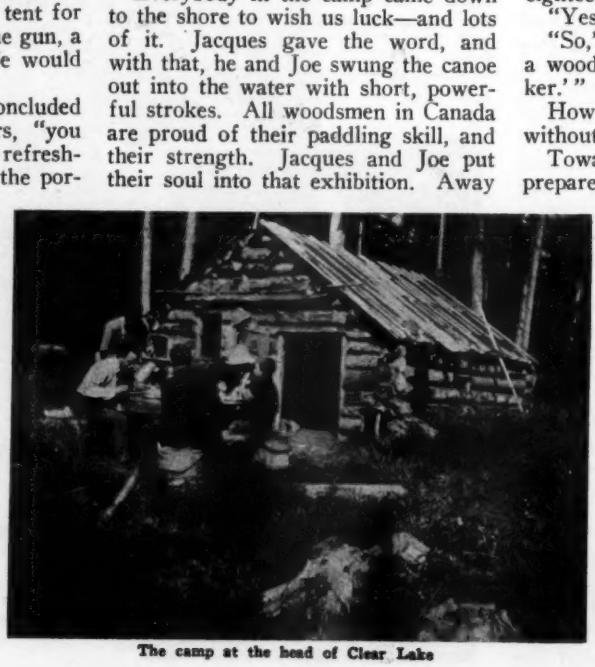
"So," he finished, "I put the radio in a wooden box, marked 'Johnny Walker.'"

However, we had very poor results without an aerial. The guides sniffed.

Toward evening we landed, and prepared for a two-mile portage. Each one of us had to carry a big load as it would not be practicable to return for any part of our equipment.

The land rose up to a high ridge that we had to cross. Bending low under our burdens, which we held on our shoulders, a strap hooked to the baggage and passing around our foreheads, we stumbled over rocks and bushes, clutching at boulders, or saplings, or any object that might offer a means to pull us up the incline.

Gnats and small, black flies gathered around our heads in black swarms. They flew into our eyes, crept into our



The camp at the head of Clear Lake

nostrils and ears and crawled down our necks. We began to realize the tortures of a portage. The need for economizing in equipment was obvious.

Halfway up, Dr. Hobart's load caught on a low branch, pulling him back on his heels. He struggled for a moment, clutching at the air. And then he toppled over.

"Be yourself, Doc!" I yelled.

"Shut up!" he growled.

The laugh froze within me. The radio was in his pack!

Over the ridge, we stopped to rest. Below us was a great dam under construction. The workmen's camp lay at the edge of a clearing that somehow reminded me of a circus. It certainly seemed out of place. A great wall of concrete towered above — reached above the tree tops. At the furthest end steel rods projected from wood palings. Derricks swung huge iron mats over the heads of workmen and dropped them into place. A tremendous activity covered the ground for acres around. But the scene appeared to be a miniature puppet show. The tiny figures appeared to be occupied with senseless, futile tasks, lost in the vast wilderness that seemed to smother the puny efforts of man.

The foreman told us that British interests were building a dam that would require eight more years for completion. When finished, he informed us, it would furnish enough electric power for the North American Continent. The builders forbid any publicity because they feared opposition would result should the Canadians learn of the extent to which the dam would inundate the surrounding country with water.

That evening we entertained the men of the camp with our radio. They offered to take up a collection for the set if we would sell it. Upon refusal, however, we were oath-bound to send them a good one when we reached civilization again.

By six the next morning, our little party was loaded into the canoe, and our journey down the "White Water" commenced.

Dr. Hobart trying to cook a strip of bacon on the end of a forked stick. He couldn't accomplish the feat satisfactorily. This is where we made camp at the mouth of White Water

In Canada there are many unnamed rivers called "White Water" because the water flows between high cliffs at a terrific rate, whipping the center into foam.

Jacques informed us that we would travel that day without stopping (if luck was with us) until late at night. Not only that, but we would also travel in the exact center of "White Water" or lose our equipment as well as our precious persons.

The canoe was launched. The black, swirling water caught the craft with a jerk. A few swift strokes of the paddles projected us into the foam. A sickening lurch threw us around, and head on into the spray we hurtled at a furious speed.

We seemed to be riding higher than the shore water. Conversation was impossible most of the time. Occasionally Joe, the Indian, would lean forward, point his paddle, and then, with a yell, plunge it into the water, elbow deep. The canoe would shoot around a boulder. Jacques would pull our craft around into its course with a deft twist of his paddle in the stern. And again we would plunge and leap down the "White Water."

All day we rode the crest, every minute a hair-raising experience. Long into the evening we kept on our course.

A steady, high-pitched swishing sound caught my attention. It grew louder. The noise resembled escaping steam. I leaned back to ask Jacques what it was. He nodded his head indicating that I should look forward. I did.

A solid mass of white loomed up. The river ahead was seething foam, boiling over rocks, spurting up from the cliffs at each side, rolling back over itself in licking tongues of black water flecked with white.

I grabbed Dr. Hobart. The next instant I was blinded with spray. Water poured over my head. I gasped. The canoe keeled over, jerked to the left, skidded, then swung to the right. A deafening roar lulled my senses. A crash—water—more water—

We glided along evenly. I opened my eyes. Joe was laughing.

"All right, boys!" Jacques cried from the stern. "We rode the rapids and only lost a paddle."

The shore line sloped down to the lake ahead. We pulled over to the bank, fastened the canoe, and jumped ashore to stretch our cramped legs.

While Dr. Hobart and I examined the radio, the guides put up camp. It was 10:00 P. M. by my watch. The sun had just set, and darkness had begun to settle over the still forest.

Never in my life have I enjoyed a radio set as I did that night. The four of us lounging around the camp fire listening in on the organ prelude, "Adagio," from First Organ Sonata by Mendelsohn, broadcast from WGY, our silhouettes thrown out into the dark amphitheatre that lay below the interlocking branches of the trees, reminded me of many Arabian Nights' tales of magic boxes working their wonders in the enchanted forests.

(*Continued on page 78*)

Looking across Pike Lake from the Indian camp. Something of the immenseness of the Canadian Wilderness can be detected here

The Right and Wrong of Receiver Tuning

How to Prove That You Are Right and the Other Fellow's Wrong—L. O. Marsteller, Radio Engineer, Westinghouse Electric & Manufacturing Co., Tells How Different Types of Receivers Should Be Tuned

A RADIO listener tuning in late on a program can be just as much of an annoyance to those around him as if he were actually arriving late at church or concert or theater, making a noise and fuss about getting his seat, and obstructing the view.

Do you tune by the hit-or-miss method? But you would not play baseball that way, or tennis. You would break other people's windows. You wouldn't play bridge that way, or you would likely break your own pocketbook and your partner's heart. A logical, scientific method of doing anything is always to be preferred. It gives the best results, the greatest satisfaction and causes the least trouble.

You have probably very little idea of the amount of trouble you cause by tuning your receiver by a hit-or-miss method. Every night you may—unknown by yourself—be causing a horrible annoyance to the neighbors with whom you most desire to keep on friendly terms. If your formerly sociable neighbor for some unaccountable reason avoids you, or frowns at you or looks a frigid scorn at you—just consider if you have possibly been tuning some of your unskilfulness and thoughtlessness into his radio receiver night after night. What wonder he cuts you dead, or slanders you!

Yet it is so very easy to tune your receiver in a proper and entirely unobjectionable manner. Here is the way of it.

* * *

There are several types of receiving sets which will act as transmitters, and which will, if improperly tuned, annoy your neighbor with squeals and whistles. One of these is the single circuit receiver. There are two controls on a single circuit receiver. One of these controls is known as a tuner handle or knob. This control makes it possible to tune in one station and eliminate another. The other control is a tickler or intensifier. Its purpose is to increase the signal strength. Both tuner and tickler should be operated simultaneously. Now let us consider the proper operation of this set.

Tuning the Single Circuit Receiver

With the tickler set near zero, bring the tuner control to approximately the setting where you would expect to find the desired signal, and, with the other hand bring the tickler control up to the point where a slight hiss or rustle is heard and keep the tickler so adjusted as you more accurately tune in the signal. Never increase the tickler beyond the point where the hissing sound is heard or you will hear a whistle or squeal, indicating that you are sending out an interfering wave which will interfere with your neighbor's reception.

If a slight change of the tuner adjustment causes a squeal or whistle to be heard, you should immediately remedy matters by decreasing the tickler until the whistle disappears. If you do not decrease the tickler setting, your set will continue to act as a transmitter and radiate an interfering wave. This will cause your neighbors to receive a whistle mixed in with the concert music from the broadcasting station. Many times music of excellent quality is condemned because of the interference caused by the wave sent out from a neighbor's receiving set.

With a very little practice the single circuit receiving set can be operated night after night without causing any interference.

Another type of receiver which often finds a place in the amateur's home and sometimes is used for broadcast reception, has one more control than the single circuit set, making a total of three controls. This is known as the three-circuit regenerative receiver.

The Three-circuit Regenerative Receiver

One control tunes the primary or antenna circuit and the other tunes the secondary or tube circuit. The third control is marked tickler or intensifier. This receiver is very selective but requires considerable skill and patience in order to tune in weak signals. As this type of receiver has three controls, and, as the average person has but two hands, it is rather difficult to keep the tickler properly adjusted as the primary and secondary controls are operated. The general tendency is to set the tickler to maximum and then tune the primary and secondary until the whistle-like note of a broadcasting station is heard. That means that the operation has probably interfered with your neighbor's reception of the concert.

For people who only have two hands, there is only one way to operate such a set and not cause interference,

In this pleasing radio atmosphere in an exclusive Manhattan millinery shop it should be a joy to select a hat; but the purpose of this picture is to show how NOT to tune your receiver. Two controls demand the use of both hands. The radio receiver is like all good musical instruments in this respect

that is, to calibrate the secondary circuit by marking the proper setting down on a chart. Then to tune in a station it is only necessary to set the secondary control to the proper point as determined from the calibration chart and adjust the tickler to the point where a slight hiss or rustle is heard as the primary circuit is tuned to the desired signal. This type of receiver should be used only when it is at a sufficient distance from other sets to preclude the possibility of interference.

UNTUNED RADIO FREQUENCY RECEIVERS

So far we have considered regenerative receivers which are thought by many to be the sole source of radiation. But this is not the case. In sets which introduce radio frequency amplifier stages, oscillations may be set up which radiate as effectively and cause as much annoyance as the regenerative receivers. The oscillation of the radio frequency amplifiers may be prevented by means of the potentiometer or stabilizer.

This picture shows Mayor George E. Leach of Minneapolis tuning his set properly. His right hand is adjusting the regeneration control while his left hand manipulates the wave-meter dial

The only practical way of determining the point on the potentiometer dial beyond which the tube will oscillate is experience in tuning this set. As the effect of tuning this dial is noted, one should remember for the commonly used wavelengths the critical points on the dial, at which the oscillating effect becomes audible in the phones or loudspeaker—and thereafter be careful to adjust to those points and not a bit beyond.

How far will any of these types of receivers transmit? Any one will cause interference over a distance of four city blocks and can under most favorable conditions be heard six blocks away, or even much farther.

So every radio listener should remember: When the detector tube of a receiving set oscillates, the antenna connected to that set radiates energy which is picked up by neighboring sets in the form of "birdies" and squeals. Actually, of course, these "birdies" or beat notes are the audible frequency difference between the inaudible high frequency wave transmitted from the broadcasting station and the inaudible high frequency current produced by your oscillating detector tube.

Correct Tuning. The Reverend John G. Gebhard of Mount Vernon, N. Y., knows how to get the best results from his set. And, being a divine, he practices the Golden Rule. With his left hand he controls regeneration while the right adjusts wavelength

You can usually tell when your tube is oscillating by a peculiar change that takes place at the beginning of oscillations. There is often a slight swish or rustle as the tickler reaches the oscillation position and it should be backed slightly below this point.

Your search for a distant station should always be made with the tube near to, but always below, the oscillating point and the tuning can then be done with no inconvenience to anyone.

One more caution: You must not be satisfied that because you hear no squeals in your own receiver you are causing no disturbance in that of your neighbor. You may obtain quite clear music or speech from your own, yet your set may be oscillating and a few meters from you your neighbor is receiving your radiation and that from the station at the same time. At times they add and give double strength and then they substract and cancel the unmodulated carrier wave from the station, causing a doubling of pitch. So your neighbor's program is ruined without any apparent beat note, and the trouble is not apparent at your own receiver.

An effective method for determining if your set is oscillating is the following:

In tuning, when you come to the station you desire, turn the wavelength control dial back and forth over the spot where the station is found. On either side of the exact tune there may be noticed a squeal rising in pitch as you leave the station. If this condition is present, your set is oscillating and the tickler should be turned back. Do not be tempted to turn it forward to get additional volume.

In radio every listener-in should conform to the Golden Rule.

Broadcasting Station at Santiago, Chile

ONE of the best of the South American broadcasting stations is that of Santiago, Chile. This station has a power of 500 watts, and operates with a wave-length of 460 meters. A distinctive feature of its broadcasting is the use of an assortment of microphones so that an appropriately designed microphone may be employed with each different class of instrument—string, woodwind, voice, etc., thus enhancing the quality of transmission of musical programs, which have been heard satisfactorily in Buenos Aires, Bahia, Blanca, Bolivia and Peru.

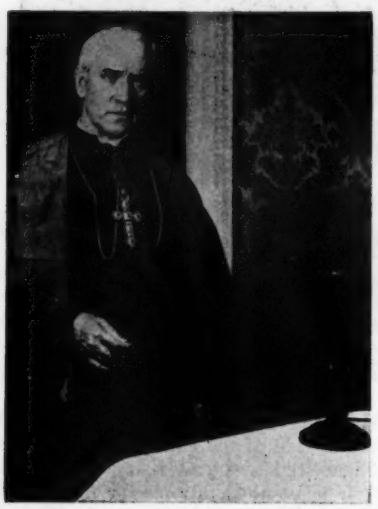
Brazilian Broadcast Stations

PERMISSION to establish four radio broadcasting stations has been granted by the Ministry of Public Works of Brazil to the Brazilian Radio-Telegraph Company for the purpose of broadcasting information, lectures, concerts, etc. The four stations are to be located at São Paulo, Bello Horizonte, Bahia and Pernambuco.

This past year the Radio Society has been active in Rio de Janeiro and now counts about 800 members. This society has been operating a small 10-watt broadcasting station at 10 Avenue Rio Branco.

Peeps into Broadcast Stations

Service and Song Together



Patrick Cardinal Hayes broadcasting from WEAF

MR. FRANK E. MULLEN, Radio Editor of "The National Stockman and Farmer," writes us:

"The radio industry in discussing broadcasting has been concerned too much with the entertainment side of radio, which is necessarily a changing phase, and too little with the service side of radio, which is certain to endure.

"In your April number, the music controversy, the future of radio, and what is to be done, was discussed, but with little or no mention made of the service features of radio. The entertainment problem was emphasized . . . ."

* * *

ENTERTAINMENT, up to April, was paramount. The Press, over the entire country, has emphasized that phase of broadcasting. But a change is already upon us. Entertainment has blazed the trail for the service features of radio. From entertainment and service combined, culture evolves. We may have national service, with the improvement of broadcasting, and perhaps, soon, have an intimate international relationship founded on international service.

* * *

MR. MULLEN continues: "Our experience has been with a particular radio audience that will inevitably use radio primarily as a service and enjoy it as a blessing to life. We do not mean to minimize the importance of music and other radio entertainment. They are essential, but radio could and would live on service alone were all artists, musicians, composers, etc., in the world to go on a permanent strike. It is equally true that such service warrants, and will receive compensation of some sort; that is to say, the service is so essential that it will be paid for if need be."

* * *

SHOULD all the artists, composers, and musicians go on a permanent strike, this world of ours would be a sad place. And one wonders, too, whether the service of which Mr. Mullen speaks would have gained a foothold had there been no entertainment to encourage the building of broadcast stations sufficiently powerful to reach a wide area.

Anita Brown, National Radio Chairman, League of American Pen Women, broadcast from WJY

An enduring broadcasting service in America must function as entertainment, or at least be closely allied with features that entertain.

The American people study their political lessons by cartoons. The "Congressional Record" with its gratis circulation has probably little influence as compared with the Sunday newspapers carrying comic supplements.

The churches employ organ recitals and choir singing.

* * *

ENTERTAINMENT is essential in radio broadcasting; but broadcasting has unquestionably progressed toward greater service.

The National Conventions this June will be attended by radio millions who could never before attend. Many will listen in who could not otherwise afford the time and expense to go direct. Many others will listen in who have been reluctant to attend any sort of a political caucus merely because they felt that a lack of understanding would hardly reward the effort expended.

Through broadcasting we will learn American politics. We will learn the fundamentals by radio, and then *read* the embellishments with a well balanced perspective.

* * *

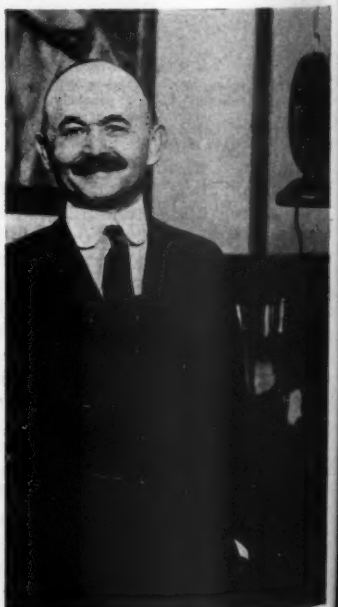
SOME years ago, a convention of religions was held in Chicago. Among others, were represented Christianity, Mohamedism, Brahmism, and Budhism. The history of religion was reviewed. Then notes were compared.

Many people were astonished to learn that some of our most valued axioms are in the Bible of Brahma faith; "penny-wise and pound foolish," and "do unto others as you would have others do unto you." In fact, the Golden Rule was found to be the key-note of Hindu religion.

The Mohamedans teach five points of which "give honest weight," and "revere thy father and mother" are examples commonly thought to be Christian tenets.

The followers of Buddah believe in brotherly love. That isn't a bad religion.

And the Christians discovered 144 different sects in this country alone. A little more knowledge of religion



Judge Ben B. Lindsey, famous juvenile court judge of Denver, broadcast from KHJ

Mildred Delma, coloratura soprano of Metropolitan Studios, broadcast from WJZ

and religions won't hurt any of us. Perhaps broadcasting will serve us in this way, too.

* * *

BROADCASTING will render a profound service this summer. Broadcast stations have increased their programs of religious services. Those who want it will have it. Those who are indifferent to church activities will profit in spite of themselves.

For in broadcasting we may hear the best services, and of a divergent character. We may listen in on debates that have engaged theological scholars for centuries. We will learn some of the fundamentals of religion, unknown to us before, and then we may be inspired to *seek* the history and philosophy of religion; and imbibe a little of the wisdom of the ages.

* * *

SHOULD broadcasting do little more than pique our temperamental curiosities it has truly become a service.

Politics concern our economic structure. Religion has to do with our spiritual existence. Broadcasting will surely open our eyes to many things in each that we have not yet learned.

Tune in on both this summer.

"OUR present system of broadcasting market reports," continues Mr. Mullen, "includes three reports daily and two weather reports from KDKA. In the morning, the crop and market information, as released by the United States Department of Agriculture, is broadcast after the live stock quotations have been given. At noon the weather forecast is given, the Pittsburgh livestock market repeated, a report on wholesale fruits and vegetables, and miscellaneous reports. Our evening broadcast includes a report on nine principal livestock markets: Chicago grain, New York Cotton and Sugar, Feeds at six primary markets, Baltimore and Philadelphia grain, Pittsburgh wholesale produce and dairy products. Toledo Seeds and Chicago butter and eggs.

"The reaction to the above broadcast has come from 47 states, Canada and Cuba."

Manifestly a fine record of a year's splendid service!

Above: Wendell Hall, the red-headed music maker, broadcasting from WEAF

Below: Ernest Hare, Larry Briers and Billy Jones, the Happiness Boys trio of phonograph fame, broadcasting from WEAF

Mrs. Minnie Maddern Fiske, the famous actress, broadcast from WJZ

* * *

MR. CHARLES TITTMAN has appeared with New York Symphony, Philadelphia Orchestra, Detroit Symphony, Baltimore Symphony, New York Oratorio Society, Chicago Apollo Club, at Bach, Cincinnati, Cornell and Spartanburg Festivals, at the New York Oratorio Society Festival of 1920, etc., and in recital at prominent colleges and for leading music clubs. He is an American, born and trained in America, a graduate of Princeton and of the Harvard Law School, and occupies a distinguished position on the American concert stage. He is particularly well known through his many appearances at the celebrated Bach Festivals, and in concert he has sung with such distinguished artists as Matzenauer, Garrison, Mary Garden, Heifetz and Casals. In festival he has appeared with most of the great stars of the day, including Homer, Raisa and Martinelli. In recital he has been particularly well received.

He returned to the

Keith McLeod (left) accompanist at WJZ. Mr. McLeod is a musician worthy of the position to which his ambition is now leading him. (Below) Edward A. Kaminsky, Paul Hyman and Mack Stock. This trio accompanied by McLeod "put over" the last Wireless Age party from WJZ. Alfred Armand was the leading soloist

concert platform in 1920, after service as First Lieutenant, Captain and Major in the Army. Since, he has become a Victor artist of renown.

And that is why his appearances before the microphone at WRC have been worthy events. It will be well worth your while to listen in on Mr. Tittman at any time he may broadcast.

But don't let it go at that. Learn about your broadcast artists. Tune in on their performances. Your radio is a season ticket to the concert halls of the country.

* * *

A POPULAR feature of CKY'S programs are the readings from the works of Rudyard Kipling and Robert W. Service, which are given by D. R. P. Coats. Recently the announcer commenced a series of readings from the works of Charles Dickens. Following "Sidney Carton's Farewell" made famous by Sir John Martin Harvey, a schoolmaster wrote to CKY congratulating the station and saying that the readings had proved of special interest to the students of grade eleven who were reading "The Tale of Two Cities" as one of their texts for the year. The schoolmaster suggested that readings might also be given from Shakespeare and from other works in use in the schools. Accordingly, CKY is taking the matter up with the educational authorities, and pupils in the Prairie Provinces are to have an opportunity of hearing extracts from works, which they are studying, read over the radio.

Our educational system seems to follow in the wake of progress. It has been hard to understand why moving pictures have not been exploited in the schools to a greater extent. Perhaps, however, broadcasting will promptly enter the curriculum of teaching. Moving pictures and radio might well be combined for the teaching of subjects that are now difficult to learn.

* * *

PRESENTING the greatest assemblage of leading orchestras and famous recording artists which radio broadcasting has ever known, station WJZ of the Radio Corporation of America transmitted the entire program of the annual Banquet and Entertainment of the Talking Men and Radio Men, Inc., direct from the grand ball room of the Hotel Pennsylvania. Through the courtesy of the American Association of Authors, Composers and Publishers, WJZ was able to broadcast all numbers controlled by the Association copyrights, insuring the listeners-in a continuous program of unequalled entertainment.

Among the orchestras and entertainers who were presented to the radio audience in unbroken succession from nine o'clock until the end of the program was Paul Whiteman and his Orchestra, Selvin's Boardwalk Orchestra, Coleman's Mont Martre Orchestra, Vincent Lopez and his Orchestra, Paul Specht's Orchestra, Ace Brigode and his Ten Virginians, Ambassador Orchestra, Garber-Davis Orchestra, Piron Orchestra, International Novelty Orchestra, Keating's Ramblers Orchestra, California Ramblers, Marion Harris, Van and Schenk, E. Ricard, Irving Kaufman, Colin O'Moore, Brooke Johns, John Steele, Brox Sisters, Marcia Freer, and Eddie Cantor.

All the performers are famous recording artists, and many of them are radio feature performers. Their presence at the banquet and the broadcasting of the program was made possible by courtesy of Landay Brothers Music House, and the Brunswick, Columbia, Edison, Okeh, Victor, and Vocalion Companies.

* * *

A NEW invention has made possible the recording of broadcast programs on records which may be rebroadcast, and then again recorded.

The all-star assemblage, broadcasting from WJZ, should have been recorded. The records could then be preserved for their historical value. Two years from now we may have occasion to study the evolution of broadcasting. It would be interesting to know in what direction we had advanced.

* * *

THE enterprising State College of Washington studied the broadcast situation from a practicable point of view; the service facilities. Satisfied that a broadctst station which would devote itself primarily to information and high class entertainment would be almost a necessity in a public educational institution, the authorities immediately proceeded to raise the necessary funds. Support was secured from the student body, citizens of Pullman and nearby towns, and the alumni was solicited.

The Government gave the State College of Washington an exclusive

Mme. Tamaki Miura, the "Madame Butterfly" of Japan, recently sang from KYW in Chicago while her mother listened in at Tokyo. Mme. Miura received 10,000 requests for her autographed photo from the United States, Mexico and Canada. She autographed her name in Japanese and English, requiring 20,000 signatures

wavelength, 330 meters, and christened the Station KFAE.

The station then invited all listeners to send in their preferences in program material. KFAE now broadcasts basket ball games, talks on agricultural engineering, the migration of birds, chemistry and other educational subjects, orchestral numbers, solos, and talks on books.

The programs are developed through the activities of the faculty and students under the management of Arthur J. Kralowec, a senior student.

Tune in on KFAE. Then decide whether you have any definite ideas on broadcast service.

* * *

RADIO fans all over the country will be fortunate this year in being able to hear the opening Pop concert at Symphony Hall, Boston, played by members of the Boston Symphony Orchestra which will be broadcast by Station WBZ, Boston Herald-Traveler, Westinghouse. These concerts are conducted by Agide Jacchia, directing a symphony of 80 players which is adequate for playing the most elaborate modern score.

H. V. Carpenter, Dean of Mechanical Arts and Engineering, supervised installation of KFAE

These Pop concerts are so much a part of Boston as the Common or the golden-domed state house and they are unique in the fact that there is nothing like them anywhere in this country. In the summer of 1885 the project of a supplementary series of concerts to the regular season of the Boston Symphony Orchestra, of popular character to suit the warmer season, was inaugurated. After the example of Bilse concerts in Berlin, the formal rows of seats were removed, tables installed and refreshments were served.

The experiment was an instant success. The "Promenade Concerts" soon came to be called the "Pops." While

Mary Ellis, Arthur Hammerstein's new star, broadcast from WJY

the Pops of this the 39th season follow the original idea to some extent, the idea has been enlarged to a great extent. In the first place, the orchestra has grown considerably—its full symphonic proportions are adequate and the music is taken somewhat more seriously, although light trifles for encores, waltzes, operetta selections, remain an integral part of the Pops.

This is Agide Jacchia's eighth season as conductor of these concerts. A native of Pesaro, Italy, he became a favorite pupil of Mascagni at an early age in the Conservatory of that season, Mr. Jacchia made an immediate mark as a young man as a conductor in the principal opera houses of Italy.

Since coming to this country, Mr. Jacchia has conducted opera from coast to coast and from Canada to Central America. During the season of 1914-1915 he was the principal Italian conductor at the Century Theater in New York. He is the founder and director of the Boston Conservatory of Music.

* * *

North Hudson Kiwanis Club Quartet broadcast from WJZ

"I SEE by the Papers" is the title of a new radio series offered by "Hollywood" McCosker and scheduled to be broadcast weekly from WOR during the summer months.

The series is to be a humorous résumé of outstanding news events patterned after the style of Will Rogers' satire on well known people and events of national importance. Mr. McCosker, who is a newspaper man and motion picture critic well known to the radio audience, will offer the new series throughout the summer at which time there is a pronounced let-up in the release of big movies.

"Hollywood" is of the opinion that radio programs are lacking a humorous vein and that thousands of the radio audience will welcome the unconventional. "In any event," he writes, "my attempting to kid the week's news is a good joke to start with."

* * *

Charles Tittman, America's leading Oratorio Bass, broadcast from WRC

ALTHOUGH the Chautauqua Circuit has eliminated "Jazz" and humor, particularly comedians, this season, because those numbers have not been requested, the radio audience will probably welcome a smattering of something light with their summer programs of politics and religion.

B. C. L.'s now have greater advantages than Chautauqua audiences have enjoyed in the past. Cultural programs in broadcasting will show continual improvement. Also we shall have humor. We need some humor. Humor is a great educator.

—W. A. H.

RADIO NEWS FROM ALL OVER THE WORLD

Leper Colony at Molokai, Hawaii, Hears KDKA

THE great amount of enjoyment that radio broadcasting has brought to those isolated from the rest of the world is clearly shown in a communication just received at Westinghouse Station KDKA, from the Kalaupapa Leper Settlement on the Island of Molokai, Hawaii, said to be the loneliest place in the world.

Recently under the personal supervision of R. L. Cooke, superintendent of the Wireless Department of the Mutual Telephone Company of Honolulu, two radio receivers were installed in the leper colony. The radio sets consisted of a Radiola V, equipped with an A. C. power amplifier and an R-3 Magnavox which was installed in the amusement hall; while a Radiola II, for ear phone reception was installed in the superintendent's home.

The very first time the sets were placed in operation, KFKX, Westinghouse repeating station at Hastings, Neb., was received repeating KDKA's program. Then a few minutes later KDKA was picked direct.

Later KDKA was again received with such good volume that the music and other entertainment could be heard about 100 yards outside of the hall.

There are about 600 people in the Molokai leper settlement. About 400 were present for the first radio night.

The leper colony is located on a long narrow point of land surrounded on three sides by the ocean and backed up by steep cliffs, 1300 feet high which are practically unclimbable.

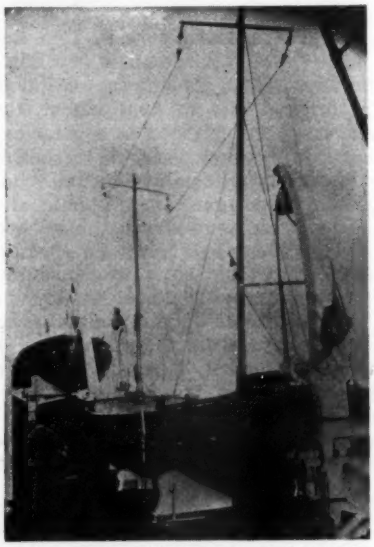
There are only two ways of entrance, by sea or over the steep mountains, down a narrow trail that seems to drop right out from under the cliffs. The two radio receiving sets were packed down this trail.

In the future these afflicted people outcast from the remainder of the human race will at least hear from the outside world through the medium of the radio wave.

Janitor Must Know Radio

IF builders throughout the country continue to erect apartment houses and furnish tenants with radio entertainment from a central receiving station, janitors will have to be able to operate receiving sets and handle complaints.

In Washington, several apartment owners object to numerous aerials of many different types, which they claim disfigure the roofs. Other landlords, more thoughtful as to the comfort and happiness of tenants, are installing one aerial with a receiving set in the basement and running wires to sockets in each apartment so that occupants who desire may plug in phones or loud speakers.



LIFE BOATS EQUIPPED WITH RADIO

The newest Giant of the Seas, the steamship "Columbus" of the North German Lloyd Line, which arrived recently in New York after her maiden voyage, has the most up-to-date equipment in its radio installation. Passengers on this vessel will feel greater safety when they observe the lifeboats equipped with radio. The boats have small receiving and sending sets, with aerial as shown in the photograph

"Listening In" in Lombardy

THE Italian society "Amici del'Arte" has constituted a new branch of its activities, the "Radio Club Lombardo," with headquarters at Milan, and with sections in other cities and towns of Lombardy.

It is the intention of the organization to encourage students and amateurs of radio communication, to advance the adoption and improvement of radio, promoting and supporting the erection of well-organized stations.

The society's activity is seriously limited by the fact that, while a person or an organization may purchase a radio outfit, it is impossible to obtain the Government's sanction to use it.

Balloon Guided by Broadcast Station

A DRIFT in the upper air currents for nearly twenty-four hours, carried whither the winds blew them, two government officers had for their only means of communication the radio.

They have completed several of the free balloon flights being made from Scott Field, Illinois, by the U. S. Weather Bureau to establish the value of the forecasting theory.

A map of the country is carried in the balloon, and by information broadcast from different radio stations, they know their location and the weather reports and forecasts from Washington.

These tests are the first ever attempted, and fifteen are planned. Dr. C. LeRoy Heisinger, meteorologist from Washington, and Lieut. James T. Neely, of the army air service, who are manning the balloons, attribute the complete success of their flights so far to warnings of weather changes received by radio from various stations.

British Interest in Radio Increasing

ENTHUSIASM for radio telephony continues to grow throughout Great Britain, according to Acting Commercial Attaché Hugh A. Butler. Up to March 1, 1924, over 600,000 licenses for receiving sets had been issued. And it doesn't stop here. THE WIRELESS AGE has just received word from Mr. Arthur R. Burrows, Director of Programs of the British Broadcasting Company, whose interesting account of Broadcasting in the British Isles was published in one of our recent numbers, that the official number of license holders in Great Britain is now 750,000. He states further that it is intended to tap four new populous centers by opening relay stations at Edinburgh (2EH), Liverpool (6LV), Leeds-Bradford (2LS), and Hull (2HU) this summer.

Broadcasting in Switzerland

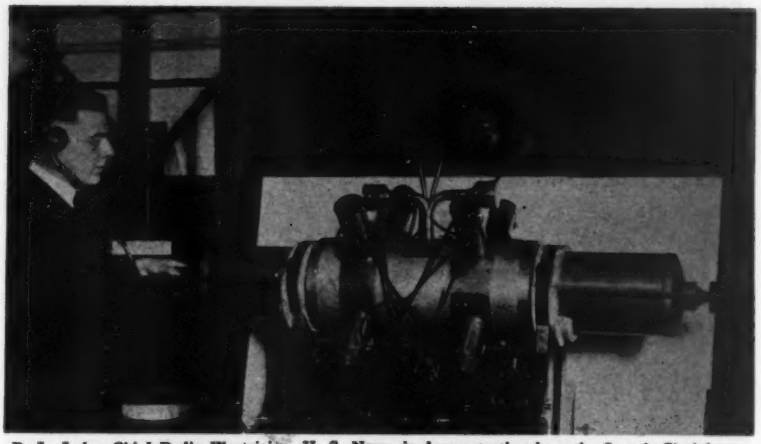
RADIOTELEPHONY as a national pastime, such as it has become in the United States and England, appears to have no great future in Switzerland. It was originally intended to erect a central national broadcasting station, but this idea has been abandoned, and a system of decentralized stations is now proposed. In view of the fact that there are only about 4,000,000 people in Switzerland, it is quite obvious that broadcasting must be kept within modest bounds.

It is reported that arrangements are being made for the erection within the near future of four broadcasting stations. They will be located, respectively, at Lausanne, Geneva, Zurich and Basel. Plans are now being prepared for the station at Basel, and the installation work will begin at an early date. The work of constructing the station at Zurich has been temporarily retarded pending certain financial adjustments, but the promoters hope to be able to complete the undertaking without much further delay.

The chief difficulty to be encountered is the expense of providing programs. The Swiss Federal Government is giving its encouragement and assistance to the undertaking, and has decided to place at the disposal of the four stations the larger part of the revenue derived from the licenses issued to amateurs. Industrial circles, amateurs, public corporations, and other interested bodies are being urged to subscribe to the scheme.

Austrian Broadcasting Company to Be Formed

FORMATION of a company called "Broadcasting A. G." is being undertaken by the Austrian Government to carry on radiotelephone broadcasting in that country, we are advised by the Department of Commerce. Applications for radio concessions from the German Telefunken Gesallschaft, the E. Schrack Radio Werke, and other companies had been pending, but it was decided not to grant a concession to any privately owned concern. A majority of the shares of stock of the new company will be held by the Austrian State.



R. L. Luke, Chief Radio Electrician, U. S. Navy, is demonstrating here the Scotch Clariphone, designed to modify the effect of atmospheric disturbances in radio reception

African Natives to Learn Farming by Radio

NATIVES in the heart of Africa will be able soon to perform their ancient ceremonial dances to the strains of jazz through a radio loud speaker, and will be given instructions in modern agricultural methods in the same way under plans of British officials of Kenya Colony.

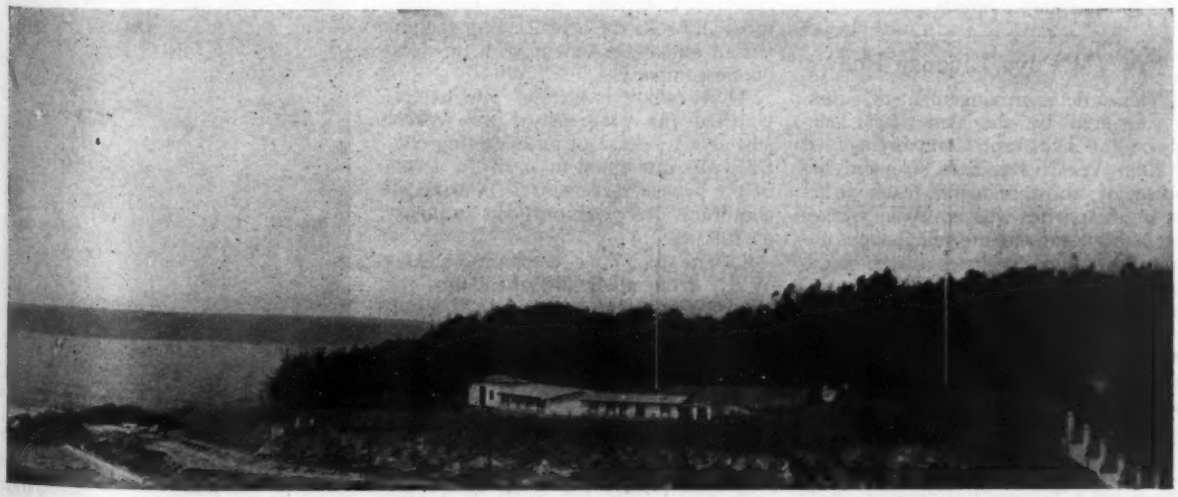
Trade Commissioner R. A. May at Alexandria, Egypt, has advised the Commerce Department that plans already have been made to institute a radio set with loud speaker in every village.

Besides daily musical programs, he said, farming instructions will be sent to the natives in their own language.

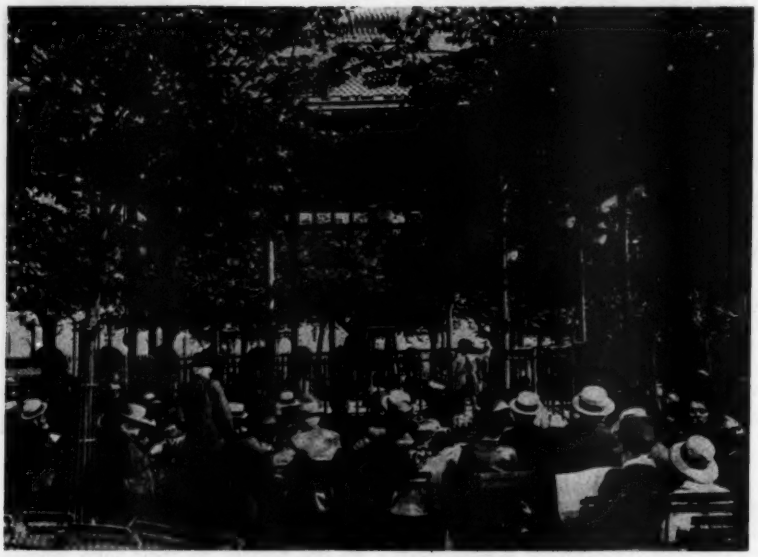
Radio "Knife" for Major Operations

APPLICATION of radio impulses to a surgeon's knife which burns its way through the tissues of the body, cauterizing as it passes and thus produces nearly bloodless surgery, is claimed by Dr. L. E. Schmidt of the staff of the Alexian Brothers' Hospital, Chicago. With the use of the new instrument two operations for cancer of the bladder have been performed successfully, it is stated.

As explained by W. H. Dodge, representative of the laboratory that perfected the device, a low power radio transmitting set is used to generate the current. The "knife," which is about half the breadth of a lead pencil and resembles a knitting needle, forms one terminal. The other is applied to the patient. The human tissue offers resistance to the passage of the current



Chile is using radio extensively. Here is the wireless station north of Valparaiso, Chile, one of many stations built along the coast for the aid of shipping. Recently a fine broadcasting station has been opened in Santiago, the capital



Here is how Paris enjoys radio in the summer-time. Concerts are broadcast from a band-stand in the Champs-Elysees

when the knife is applied. The resistance causes heat. The knife burns itself through skin, fat and muscle quickly and without pressure.

The set is equipped with two 40-watt power tubes and condensers. The current oscillates at the rate of 40,000 cycles a second. The tension is 800 volts at 450 milli-amperes. The heat developed is great enough to fuse brass.

"We don't care to make any rash statements," said Dr. A. J. Wochinski, who assisted in the operations. "Radio surgery has its limitations. It will not cure cancer, but can be used practically wherever the knife can.

"The one advantage the radio needle has over the knife is that it prevents loss of blood, unless a large artery should be severed, in which case ligatures would have to be applied. The patient is thus saved the usual shock that follows major operations."

WHN Pays License Fee

THE suit for infringement of patent brought by the American Telephone and Telegraph Company against Station WHN has been dropped because of an agreement reached between the parties whereby WHN takes out a license from the telephone company covering the use of the radio parts which were declared to be infringements. Henceforth WHN will operate on the same basis as other stations licensed to broadcast by the telephone company. The license fee was $2,000, which is understood to hold for the life of the patents.

In discussing the settlement of the suit officials of the American Telephone and Telegraph Company said: "The action taken means only that this company meant what it said when President Thayer issued his statement. Our position has been that there is nothing else for us to do but protect the validity of our patents when we believe they are infringed and put the decision up to the courts.

"We have said all along that we were perfectly willing to license any station which would respect our patents by applying for a license to operate under them. Our willingness to license Station WHN shows our intention to adhere to this position. We believe that other stations now operating with apparatus that infringes on our patents will apply for license and that this situation will be straightened out."

The only difference that will exist between Station WHN and the other broadcasting units licensed by the American Telephone and Telegraph Company is that the WHN apparatus was not manufactured by the Western Electric Company, which manufactures and sells the broadcasting sets installed under agreement with the telephone company.

The radio industry, which has watched the progress of the WHN suit as a test case of broadcasting control, was interested to learn the terms of the license agreement. Its principal conditions are given on good authority as follows:

1. The telephone company releases WHN from all liability of claims for past infringement arising out of previous operation of the broadcasting station.

2. WHN is granted a "personal non-transferable" license to continue to use the station for radio telephone broadcasting, including broadcasting for toll or hire.

3. The license fee is set at $2,000, which is understood not to be an annual fee but a sum covering operation during the life of the patents under which license is granted.

4. The present license is based on the operation of the station, with a maximum power of 500 watts delivered to the antenna, but the telephone company agrees that it will at any time, upon request of the licensee, grant a license as far as its patents are concerned to operate with greater power upon terms commensurate with the present license fee.

5. The license is subject to revocation by the telephone company upon violation by the licensee of any of the foregoing conditions.

Hoover on Radio Legislation

HERBERT HOOVER has become the Judge Landis, the Will H. Hays, the Augustus Thomas of the air.

He announced recently that he would not attempt to set up a censorship and would never consent to any scheme by which radio listeners shall be charged a fee by law.

The Government of the United States will always control the ether roads, but it will not be drawn into saying what shall and what shall not be fed to the radio audience.

"There are enough complaints now," says Mr. Hoover, "against the individual programs sent out by the various broadcasting stations. If the United States were to assume control of these programs, the kicks would be multiplied by the tens of thousands and the first thing we knew we would be having a Senatorial investigation on our hands.

"There will be," he explains, "no vested right in any one wave length.

The Eiffel Tower radio broadcasting station in Paris. Here are the tubes

There will be no monopoly of certain roads in the ether. The Government will see that the air is kept open to all comers. The Government will do

everything it can to encourage continuity of service from any one broadcasting station. Certain companies are so tied up in the development of radio that there is reason to believe they will show great vision in handling the subject. In any event, while they may control radio instruments, the Government will never lose control of the air itself and will never permit the air routes to be run counter to the general public interest.

"There has been no parallel to the development of the air as a means of communication since the invention of printing. The radio is the handmaiden of the printer. The Government will see that nothing happens in the ether to interfere with or hamper its future."

Republican Convention by Radio

MORE than one-tenth of the people of the United States, or about twelve million, can "tune in" on the proceedings of the Republican National Convention when it starts at Cleveland, Ohio, on June 10.

Radio in Mexico. A news reporter is here sending out messages from the powerful portable set accompanying the forces of General Gonzalo Escobar in campaign

Every radio set owner in the country, whether he is on the Pacific or Atlantic Coast wave length, will be able to hear the convention. Arrangements to broadcast the convention proceedings are being completed by the Radio Broadcasting Subcommittee of the Cleveland Convention Committee, headed by Charles L. Gebauer.

"More people will hear this convention than ever heard any great political event before," said Secretary James L. E. Jappe, of the Cleveland Committee. "First, there will be more than 13,000 in the public hall itself, either as participants or spectators. Then there will be a loud speaker that will enable forty to fifty thousand gathered outside of the hall to hear, and finally the proceedings will be broadcast over the land." The roll-call by States on President and Vice-President, will be broadcast.

Chess by radio. F. E. Black, chief wireless officer of the S.S. "America," indulging in a game of chess aboard ship

Standard Radio Frequency Transmissions

THE Bureau of Standards is transmitting special signals of standard frequency about twice a month. The signals can be heard and utilized in general east of the Mississippi River. These special signals of standard frequency are of use to testing laboratories, transmitting station operators, and others in standardizing wave meters and adjusting transmitting and receiving apparatus. The transmissions on June 5 will be of special interest to ship operators, those on July 7 to amateurs, and those on June 20 to broadcasting station operators. The accuracy of these signals is better than three-tenths of one per cent.

All transmissions are by unmodulated continuous-wave telegraphy. A complete frequency transmission includes a "general call," a "standard frequency signal" and "announcements." The "general call" is given at the beginning of the eight-minute period and continues for about two minutes. This includes a statement of the frequency. The "standard frequency signal" is a series of very long dashes with the call letters WWV intervening. This signal continues for about four minutes. The "announcements" are on the same frequency as the "standard frequency signal" just transmitted, and contain a statement of the measured frequency. An announcement of the next frequency to be transmitted is then given. There is then a four-minute interval while the transmitting set is adjusted for the next frequency.

The schedule of standard frequency signals from the Bureau of Standards is as follows:

SCHEDULE OF FREQUENCIES IN KILOCYCLES
(Approximate Wave Lengths in Meters in Parentheses).

Eastern Standard Time	June 5	June 20	July 7
11:00 to 11:08 PM	300 (1000)	550 (545)	1363 (220)
11:12 to 11:20 PM	315 (952)	650 (461)	1430 (210)
11:24 to 11:32 PM	345 (869)	750 (400)	1500 (200)
11:30 to 11:44 PM	375 (800)	833 (360)	1600 (187)
11:48 to 11:56 PM	425 (705)	940 (316)	1700 (176)
12:00 to 12:08 AM	500 (600)	1050 (285)	1800 (167)
12:12 to 12:20 AM	600 (500)	1150 (261)	1900 (158)
12:24 to 12:32 AM	667 (450)	1250 (240)	2000 (150)

Radio Expositions

THE Pacific Radio Exposition is planned to be held in San Francisco from August 16 to 21 in the Civic Auditorium. This exposition will be conducted by the Pacific Radio Trade Association.

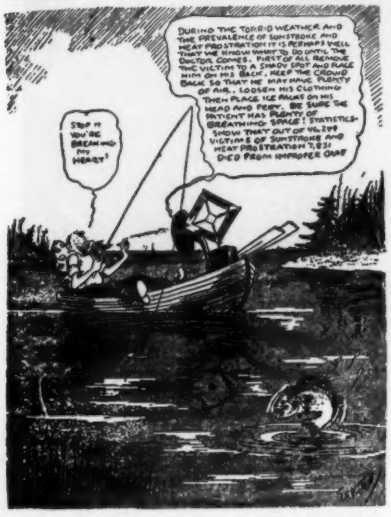
Chicago this year will be the scene of the second of a series of three shows comprising the first annual International Radio Exposition. The Chicago show will be conducted at the Coliseum November 18 to 23 inclusive.

The first show will be at Madison Square Garden, New York City, beginning Monday, September 22, and closing Sunday night, September 28. The third show will be held in a Pacific coast city, soon to be selected, in January or February, 1925.

The exposition will be under auspices of the newly organized Radio Manufacturers' Show association, with a membership of sixty. U. J. Herrmann and James F. Kerr, who made a success of the annual Chicago show, will be managing director and general manager respectively.

Best Bets in Humor

MUSIC **BY H. T. WEBSTER**


DURING THE TORRID WEATHER AND THE PREVALENCE OF SUNSTROKE AND HEAT PROSTRATION IT IS PERHAPS WELL THAT WE KNOW WHAT TO DO UNTIL THE DOCTOR COMES. FIRST OF ALL REMOVE THE VICTIM TO A SHADY SPOT AND RAISE HIM ON HIS BACK. KEEP THE CROWD BACK SO THAT HE MAY HAVE PLENTY OF AIR. LOOSEN HIS CLOTHING THEN PLACE ICE PACKS ON HIS HEAD AND PERV. BE SURE THE PATIENT HAS PLENTY OF BREATHING SPACE! STATISTICS SHOW THAT OUT OF 94,219 VICTIMS OF SUNSTROKE AND HEAT PROSTRATION 7,631 DIED FROM IMPROPER CARE
STOP IT YOU'RE BREAKING MY HEART!

—N. Y. World

H. L. M. Writes

ONE night (his letter goes) a friend asked me over to his house to "listen in" on the radio.

I went.

During the course of the evening I heard a weather report broadcast from a Colorado station.

The idea of hearing a Colorado weather report thrilled me. It seemed so—you know—impossible. That Colorado should have weather.

I asked him if I might come over the next night. He said I might.

I told him I liked it, thought it was great. I did not tell him about the Colorado weather report. That was my secret.

The next night I heard a weather report from Chicago. It was wonderful. "Cloudy in the southwestern portions, with gradually increasing temperatures," I was ecstatic. I hardly slept a wink that night. A weather report from Chicago!

I went night after night, listening raptly to reports from all sections of the country.

I bought a set of my own.

They can hardly tear me away from it.

I know what the weather was yesterday, is today and will be tomorrow in every important section of this great United States.

I don't know how I could live without my weather.

That's how I became a radio fan!

Hoping we both enjoy the concert Monday night, I remain,

Radiofanly yours, H. L. M.

THAT LITTLE GAME—BY B. LINK

YOU'RE A NOD ONE, YOU ARE.— SIT UP HALF THE NIGHT PLAYING A GAME AND THE OTHER HALF LISTENING IN ON THE RADIO AND ALLOW THE WATER PIPES TO FREEZE BEFORE YOUR VERY EYES—
DEARIE, CAN YOU BLAME ME FOR FORGETTING ABOUT THE FROZEN WEATHER OUTSIDE?— THE CARD GAME WAS A HOT SESSION AND THE RADIO PROGRAM AN OPEN AIR BAND CONCERT BROADCASTED FROM CUBA—

—Brooklyn Times

That's Easy

OKLAHOMA Radio Dealer (after lengthy explanations to Osage chief): Now I've gone over this radio set thoroughly with you; I've shown you every coil and knob, and I'd like to have your order. But is there still anything you don't understand; any questions you would like to ask?

Chief: Yes, what makes it go?

—Oklahoma Whirlwind.

The New Control

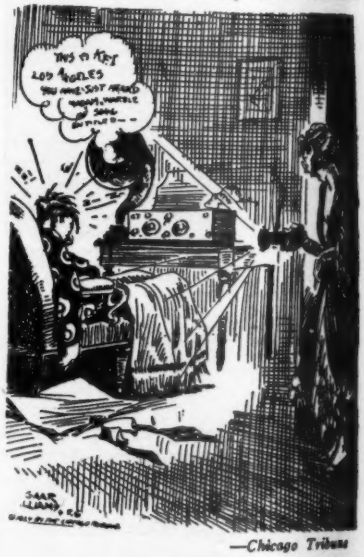
"I SEE that you don't know how to tune this set," he observed, as he began adjusting the dials. "But don't let that worry you, old man; we all have to learn, you know. Now, then," he continued, "did you notice the increased volume of sound as I turned that last dial? Just put the finishing touch on perfect reception, as it were. Of course, one cannot teach you the whole game at one sitting, but I'll say this much: you'd do well to pay particular attention to that dial if you want good volume. That is one of your most sensitive controls. Condenser, I suppose?"

"No, Bill," replied his host. "You see, it is like this. I bored one hole too many in the panel, and then put that dial on to hide the hole. It doesn't control anything—except the imagination."

—Geo. F. Noftsker.

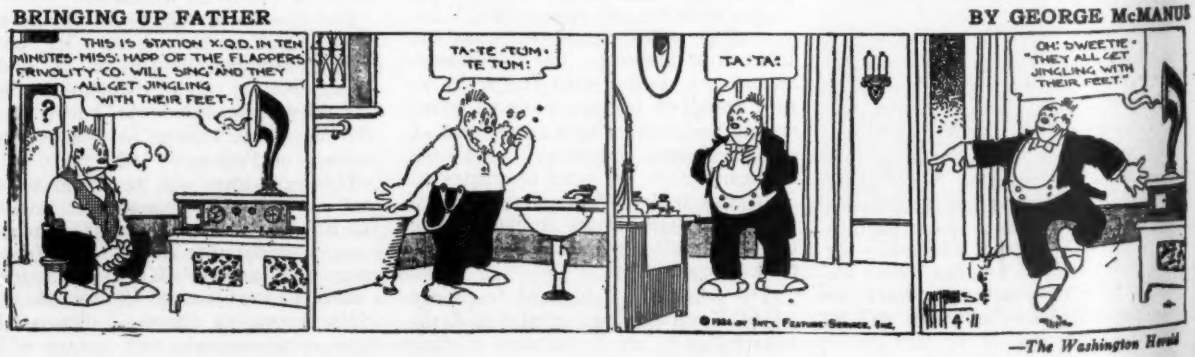
A STRAIN ON THE FAMILY TIE

By Gaar Williams



—Chicago Tribune

BRINGING UP FATHER **BY GEORGE McMANUS**


THIS IS STATION X-Q-D. IN TEN MINUTES-MISS. HAPP OF THE FLAPPERS FRIVOLITY CO. WILL SING, AND THEY ALL GET JINGLING WITH THEIR FEET-
?
TA-TE-TUM-TE TUM!
TA-TA!
OH! SWEETIE-"THEY ALL GET JINGLING WITH THEIR FEET."
4-11
© 1924 BY INT'L FEATURE SERVICE, INC.

—The Washington Herald

AFLOAT AND ASHORE WITH THE OPERATOR

By W. S. Fitzpatrick

WHEN the New York office of the United States Shipping Board was opened a wise selection was made in the appointment of Mr. Charles D. Guthrie as radio supervisor. No one could have held this position more creditably or more efficiently; none could have made a larger number of friends and no one could lay claim to greater ability or longer radio experience.

Mr. Guthrie started going to sea as a boy and long before the advent of radio. He was a cadet on the famous school ship *Saratoga,* five years after the graduation of Captain Hartley, now commander of the *Leviathan,* who learned the fundamentals of seamanship on this same school ship.

The *Saratoga* was built in 1842 and was in the fleet of Commodore Perry during the important historic event in opening negotiations with Japan in 1853. The vessel, which carried 24 nine-inch smooth bore guns, was afterward used as a slave chaser and later commissioned as a school ship.

After leaving the *Saratoga* Mr. Guthrie joined the revenue cutter service, now the all-important United States Coast Guard depending almost entirely upon radio, but which at that time had no knowledge of what radio might accomplish. It was only a little over a year previous—November 15, 1899, to be exact—when the American liner *St. Paul* transmitted the first wireless message ever sent from a ship at sea.

In 1904 he enlisted in the United States Navy and after a course at the Brooklyn Navy Yard electrical school was made wireless operator on the battleship *Kentucky.* In use then was the coherer detector with no telephone headsets, the messages coming in on tape. The record distance was 115 miles. Before the end of his naval enlistment head phones came into use and distances of a thousand miles were common through the use of electrolytic detectors.

Mr. Guthrie suggested the use of 1000-ohm phones, but was informed that none over 500 were manufactured and that 500 ohms was the maximum for efficiency!

Some time later the Schmitt-Wilkes phones, forerunners of the Brandes, were made with 1000 ohms resistance and became the Navy standard.

During this period Mr. Guthrie took part in the original radio experiments of the Navy and right here might be conferred the honor of his being the original "Broadcast Listener." It was during the Jamestown exposition in 1907 when it was his duty to listen in on an experiment made by the battleship *Virginia.* The experiment was so successful that daily concerts were given for the benefit of the fleet.

A few years later while an inspector for the Marconi company Mr. Guthrie also took part in broadcasting. On this occasion it was an effort to establish wireless telephone service between the two Wanamaker stores at New York and Philadelphia in addition to the wireless telegraph. So that the listeners at Philadelphia might pick up the signals, Mr. Guthrie would talk until hoarse, then turn on several phonograph records. This experiment was conducted at certain times each day and, while not meeting with the desired success, still brought forth letters and verbal comments from ship operators who enjoyed the concerts considerable distances at sea.

Charles D. Guthrie, Radio Supervisor, United States Shipping Board, as a navy operator twenty years ago and as he looks today

It is not recalled what kind of an announcer Mr. Guthrie made, but he probably had his little jokes and most likely introduced John McCormack to the audience before starting a phonograph record of that singer. It is doubtful however, that he hung up stars over kiddies' homes.

While still in the Navy Mr. Guthrie opened and assumed charge of the first wireless station to be built in Philadelphia. Following his discharge he became a commercial ship operator and five years later was made an inspector for the Marconi Company.

For two and a half years, which included the war period, Mr. Guthrie was chief government inspector of the second district with headquarters at New York. He became Shipping Board radio supervisor four and a half years ago.

* * *

The radio personnel of the large American trans-Atlantic passenger ships is often asked for and, no doubt, will prove of general interest.

The *Leviathan's* radio equipment is in charge of Elmo N. Pickerill of New York and George E. Sinclair, also of New York, is first assistant. The other members of the crew of eight are: Henry F. Bollendonk of Nanuet, N. Y.; Oscar L. Goertz of Brooklyn; Paul W. Karr of Skidmore, Mo.; Earl F. Whiddon of Boston, Mass.; Leslie Veader of Madison, N. J., and Roy W. Jones of Van Wert, Ohio.

H. B. Von Thun is chief operator on the *George Washington;* H. Young is first assistant; H. A. Herring, second, and Ben N. Lazarus, third assistant.

On the *America* Frank E. Black is in charge and is assisted by Arthur Cohen and J. C. Eddy.

The radio men on the new liner *Republic* are Roy Butler, E. J. Girard and N. Moore. On the *President Roosevelt* are W. L. Whitney, C. W. Butt and Louis Brown. The *President Harding* operators are George H. Kolbe, C. Prevetti and Adolph Weik.

* * *

Among the old time operators who are still going to sea is Frank W. Rosenquist, now on E. F. Hutton's yacht *Hussar,* said to be one of the most beautiful yachts afloat and on which is installed the most modern of radio equipment. Rosequist started as a commercial operator in 1912, but had an amateur set as early as 1907. During the war he was in the Radio Intelligence service of the United States Army.

(*Continued on page* 88)

A Radio Set for the Summer

How to Build It

Describing the construction of an outfit for automobile camping, the motor boat, or summer cottage which will do as well as sets made only for permanent installation

By M. B. Sleeper
Radio Designer and Technical Publisher

IF you stop to think about it, you'll probably agree that, between summer and winter, radio broadcasting really means more to us in the summer season than in the winter, not only because some of the most interesting things, particularly sporting events, come only with warm weather, but on camping trips or at summer cottages, news is not quickly available in the form of late newspaper editions. Moreover, theatres and concert halls are either closed or at inaccessible distances. Actually, we need radio more, and it is more useful to us, during the summer months, and this year, too, we want radio to bring us the news of the political conventions.

Thanks to the UV-199 tubes, you can have a set wherever you go, not an awkward, heavy affair, loaded with batteries, but a small outfit easily carried. As to the general design of the cabinet and the arrangement of the complete equipment you probably have particular ideas of your own which you want to work out. Consequently, construction data will be given in this article only on the radio set itself.

Figures 1 and 2 show the assembled instrument, consisting of a one-step non-oscillating R. F. amplifier, detector, and two-step A. F. amplifier using UV-199 tubes, while figure 3 gives the wiring diagram. You will see that the antenna circuit is untuned, with fixed coupling to the secondary which is adjusted by a .0005 mfd. condenser. In the plate circuit of the first tube—the R. F. amplifier—is another fixed coupler, or fikit, which acts as a tuned R. F. transformer.

This is in no way a trick circuit. It is an accepted design which has been in use long enough to prove entirely satisfactory as to range, quality, and selectivity. At Darien, Connecticut, we bring in the usual stations, Atlanta, Pittsburgh, Chicago, and Philadelphia with sufficient volume on an inexpensive loud speaker to hear the music and the words of the announcers easily as we sit around the room. New York stations are, of course, quite loud. While the volume is not as great as if regeneration were used, the clearness of the reproduction more than makes up for the lower volume. As a matter of fact you might think, judging by your ear, that you were tuning an amplified crystal set, because there is no carrier wave whistle nor the squeals which come from an R. F. set requiring potentiometer control.

One very important feature, and one which is entirely new, is the pickle bottle inductance. You'll understand, when you read the instructions for winding them, why they are called pickle bottle coils. It is enough to say now that they are wound in a way which makes them self-supporting. Of all types of coils the single-layer winding is most efficient. The efficiency is further increased, or the R. F. resistance lowered, in the pickle bottle coil because no insulating tube is required to support the wire. With all the effort now being spent to reduce the losses in tuning condensers, this is the first improvement on small-inductance coils which has been brought out in several years. In this connection it is interesting to note that the R. F. resistance of a spider web or basket wound coil is greater, for a given inductance, than a single-layer winding on a bakelite tube. The only type of coil having any lower losses is the single layer winding without a tube.

Information concerning the losses of spider web coils has been in possession of some of the commercial companies ever since 1917, when English army outfits, equipped with that type of inductance, were sent here to be reproduced by American manufacturers. Experimenters, however, still cling to the mistaken notion that they have lower losses than the single-layer coil.

But to get back to the set itself—the front panel is of 3-16 in. bakelite,

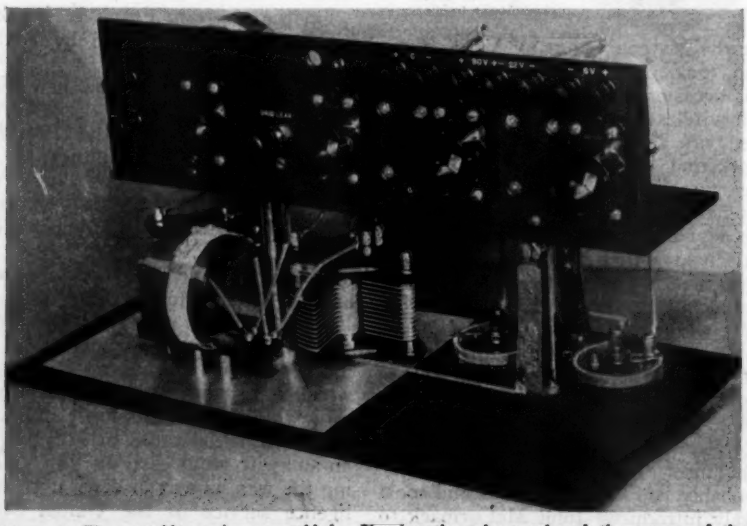


Figure 1—The portable receiver assembled. Showing the tube panel and the reverse of the front panel on which one of the R. F. pickle-bottle transformers is mounted

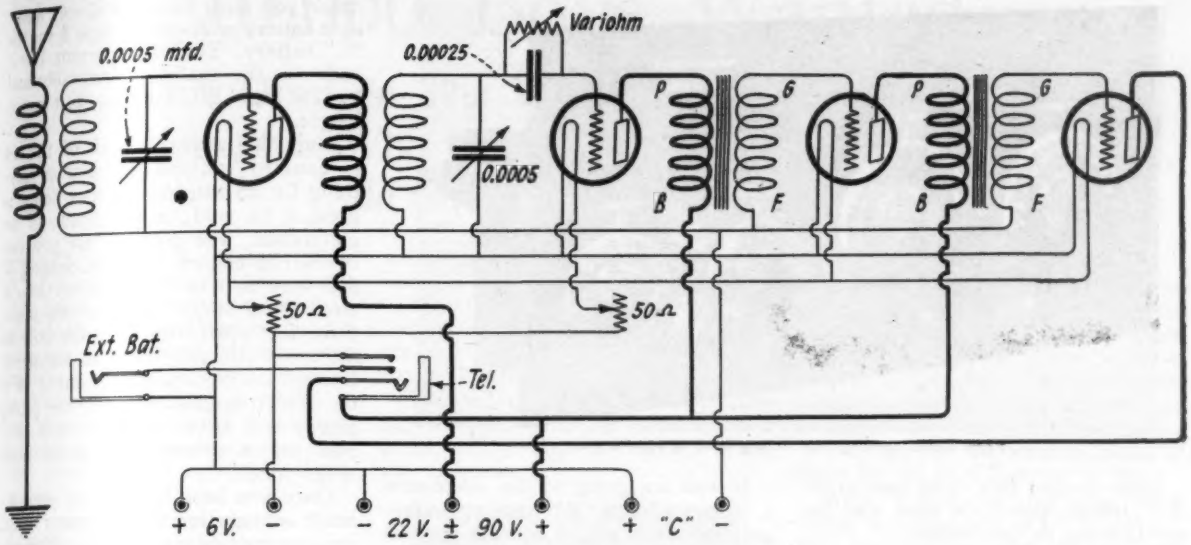


Figure 2—Wiring diagram of the portable receiver

measuring 7"x14". At the rear, supported on nickeled brass pillars ⅜"x3⅜" long, is a vertical sub panel to which a tube panel is secured. Both measure 13"x3½"x3/16". This is a very handy arrangement as it allows the tubes and transformers to be mounted behind the variable condensers, and permits them to be arranged in less space with shorter connections than if a base panel were employed.

Figure 4 gives the dimensions of the three panels. Notice that all holes are made with a No. 18 drill except the 15-32" holes for the rheostats, condensers, variohm and jacks. Four countersunk holes are made in the tube panel for the terminals of the Ark transformers. The countersinking is necessary because the terminal screws are a little short to go through a 3-16" panel.

If the drilling is changed slightly the parts from any of the reputable manufacturers can be used, but if you want to reproduce this set exactly you will need two General Instrument .0005 mfd. condensers, two 50-ohm Amsco rheostats, two 3" and two 2" Kurz-Kasch dials for the condensers and rheostats, and open circuit filament control Carter jack, four General Radio UV-199 sockets, an Electrad Variohm, a .00025 mfd. Micadon, two Ark transformers, and nine Eby binding posts. The cost of all these parts, including the screws and fittings, comes to less than forty dollars.

In addition to the items mentioned, you must have the two pickle bottle inductance units. Get a ¼-lb. spool of No. 24 S. S. C. and one of No. 20 D. C. C. wire, some gummed paper tape such as is used for fastening bundles, and two pickle or preserve bottles 2¼" in diameter, of eight to fourteen sides. If you can't get them of polygonal cross section, round ones will do. Cut four lengths of the tape ¼" wide and 6" long.

With someone to hold the spool of No. 24 wire for you, clamp the bottle between your knees, fasten the end of the wire by several turns around the neck of the bottle and bring the wire up onto the straight part. Turn the bottle and wind the wire over the strips, placing them ninety degrees apart. Moisten the tape as you go. When you have put on 70 turns, cut off the ends of the strips so that they stick out 1½" on each side of the coil, wet them, and bend them over on the wire. Thus the tape will hold the turns securely every ninety degrees. Cut the end of the wire.

Put on the primary winding, of No. 20 wire, in the same way, using four shorter strips of paper. Six turns are required, wound on top and at the center of the secondary. This coil completed, break the bottle and remove the pieces of glass carefully so as not to cut the insulation. You will then have a surprisingly strong, self-supporting inductance unit.

To mount it, cut out two 3-16" bakelite strips 3¼" long and ½" wide. Drill two holes in them at each end for screws to hold the strips together and to act as primary and secondary terminals. In addition, drill two holes 1" apart and countersink them, in one strip. They are to take screws threaded into brass pillars ¾" long by 5-16" in diameter which serve to mount the complete fikit under the tube panel. Put the coil between the bakelite strips and tighten the end screws with nuts.

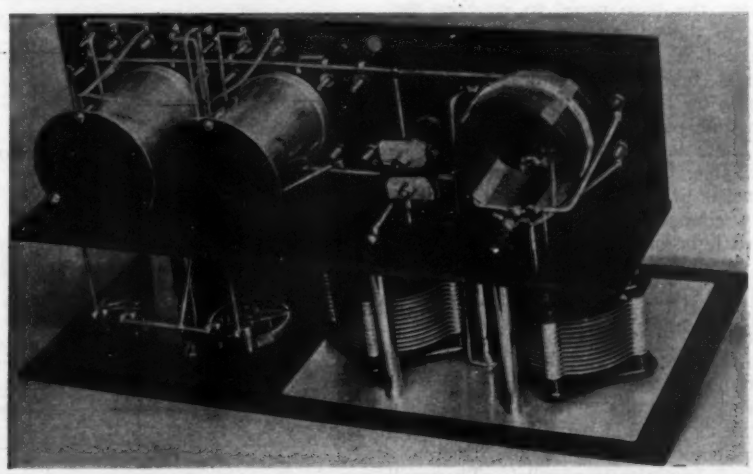
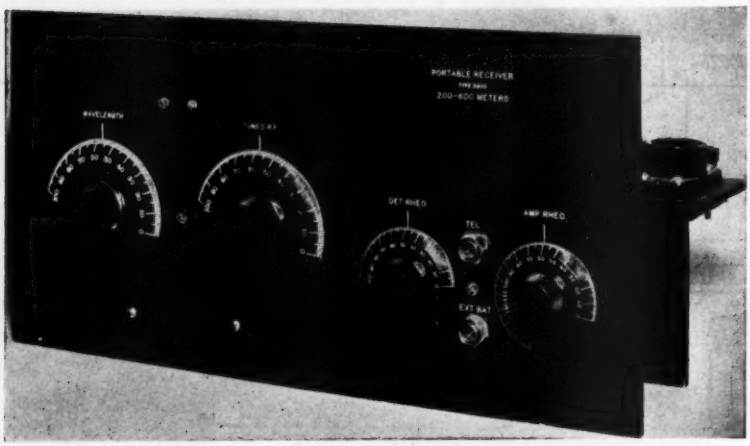


Figure 3—The assembled receiver, showing under side of tube panel on which the A. F. transformers and one of the R. F. pickle-bottle transformers are mounted



Front panel, showing best arrangement of control dials

Make another fikit to be used as the R. F. transformer in the same way, but put 12 turns on the primary.

You also need two angle brackets to fasten the tube panel to the sub-panel. They are 1" lengths of ⅜" angle brass, one with a No. 18 hole in one leg ⅜" to the right, and one ⅜" to the left of a hole in the other leg. The brackets, panel support pillars, and the coil mounting pillars are stock items which you can buy if you do not want to make them up.

Mount the instruments on the front panel and do as much of the wiring as you can. Then fasten the other parts to the tube panel, and connect them as far as possible. Notice that the socket connections must be changed. Take out the contact spring screw and put in its place a 1" 6-32 R. H. screw, with the head on top of the socket base. Replace the spring, and clamp it with a nut. Repeat this process at each terminal. The sockets are held to the panel by nuts on these screws underneath. Moreover, connections are in this way made under the panel as you will see from the illustrations.

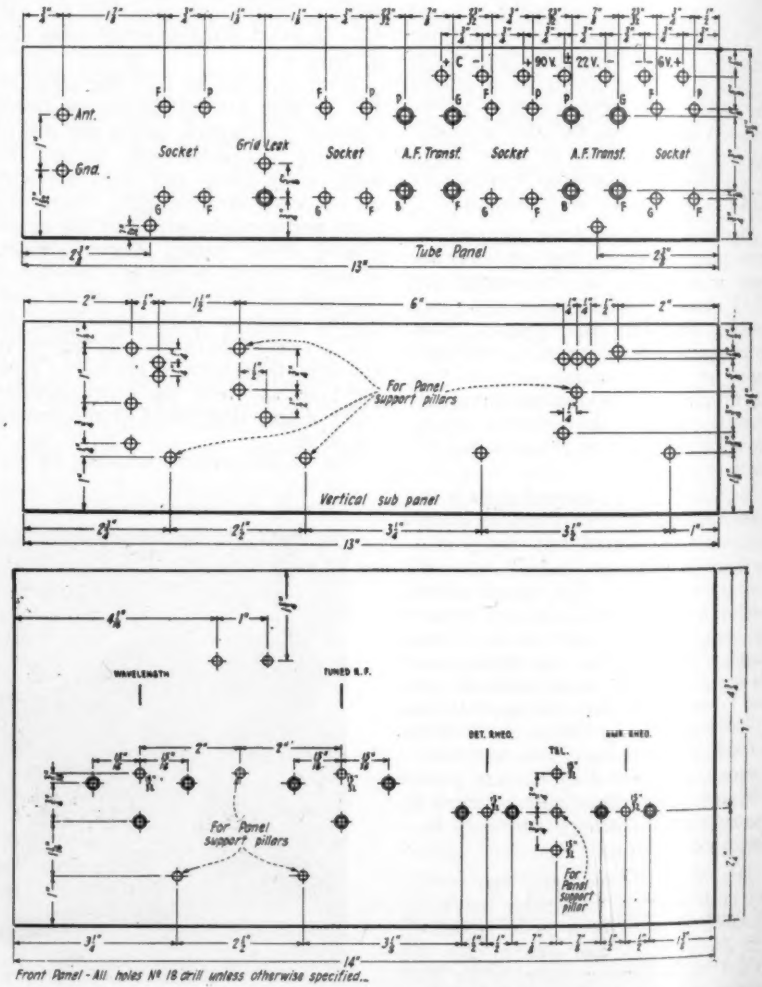
Finally, mount the sub-panel and fasten the base panel to it; then the last of the wiring can be done. Holes marked X on the sub-panel drawing are to take wires connecting instruments on the front panel to those on the tube panel.

There is a wide choice of batteries available. The lower jack on the front panel is provided so that you can plug in a connection made in place of the dash light on a motor car. Rheostats of 50 ohms are specified to take care of a 6-volt "A" battery. Dry cells can also be used for filament lighting. Three 6" dry cells, operated 2 to 4 hours a day, will run the filaments over 100 hours. Six cells in series parallel giving 4½ volts, will last more than twice as long. If weight is an important factor use four of the Eveready type 3 batteries in parallel. They will last about 25 hours.

If you are going to use telephones a tapped 45-volt "B" battery, preferably the large size, is enough, but 90 volts will increase the volume greatly. The small 22½-volt "B" batteries are all right for a few weeks though the big ones stand up much better. In addition you must have a 4½-volt flashlight battery or Eveready type 3 for the "C" battery. This is important for it improves the quality considerably and makes the "B" batteries last much longer.

Since the primary circuit of the set is untuned you can use almost anything for an antenna. A wire fence is good, a tin roof, or the frame of an automobile. For portable use you can throw one end of a 100-ft. length of bell wire tied to a weight up into a tree. On a motor boat use two wires three feet apart, run from the bow to the cross arm and down to the stern. Ground connection can be made to a tin can dropped into water, the pump pipe, a nail driven into the roots of a tree, or, on a boat, to a metal plate under water.

Once you have learned the approximate settings for the condenser dials, you can tune in very quickly. The settings will not change no matter what kind of an antenna you use. Both dials must be rotated slowly at the same time.



Dimensioned drawings of the three panels. Note that the tube and vertical sub-panels can be made by sawing a regular 7-inch panel in two

10,000 Boys Wanted

A Job Open on The Wireless Age Staff for Every Youngster Who Wants a Radio Set or Parts to Add to the Set He Now Has

BACK in 1910, the writer, then a youngster, borrowed some books from the library in his midland home town, and set about to build a radio set. At that time, however, very little was known about radio. None of the dealers carried parts in stock. In fact, that youngster had a great many obstacles in his way—even the older folks laughed good naturedly at his "notion."

But the notion persisted. That youngster wanted a radio set. And have it, he would.

One day he found a catalogue, listing a great many parts, but parts that cost too much money for an allowance of fifty cents a week. There was but one thing to do—carry newspapers. And that job brought in one dollar and fifty cents each week.

Those of you who are reading this story will know at once that on a small income of $2.00 a week a great deal of scheming and patience was needed to accumulate enough money for a full-fledged receiver.

After the set had been completed and used for some time, the youngster's ambition turned to audion detectors and other better parts. He got joy out of every improvement made. And he always wanted to improve his set still further.

The difficulties once conquered, left that youngster with one resolution—that some day he would make it easy for other young chaps to get the parts with which to build a radio set.

And that resolution has been realized! Read the following—it tells you how!

* * *

I want 10,000 young men to join the staff of THE WIRELESS AGE. Each one will be well paid. And this is how you join:

Write a letter to the Boys' Editor. Tell me whether you want a complete set; parts to go with a set you now have; or just what you do want.

Then tell me where you live and how old you are. Tell me anything else about yourself that you think I would like to know.

Bobby Carmighael, Durham, North Carolina. Bobby is an enterprising salesman on THE WIRELESS AGE staff, making good under our careful guidance. He will have his radio set earned in a very short time

And this is what I will do for you:

I have 35,000 names of people who have bought radio sets. Each one of the 35,000 will like to know more about THE WIRELESS AGE. Some of those people, in fact, have been taking the magazine, but forgot to renew their subscriptions. Those 35,000 people live in every part of the country. Some of them live in YOUR town or city.

When I have received your letter telling me what you want in radio, I will write to you and tell you how many subscriptions you must get in order to earn what you want. Even ONE subscription will get you a radio part.

And this is why you can get subscriptions—I am going to teach you HOW TO SELL. Then I am going to give you, from the 35,000 names I have, a list of those who live in your locality. In that way you become a salesman for THE WIRELESS AGE, with a calling list of people who own radio sets and, of course, will want a radio magazine. I have sent a letter to each one of the 35,000 so that they will know about THE WIRELESS AGE even before you call on them.

I now have a good many on the magazine staff earning their radio sets. None have failed to make good! And the reason is that I have wanted to make good myself and I now intend to see all the others make good.

Write to me NOW. Address your letter to the Boys' Editor, THE WIRELESS AGE, 326 Broadway, New York. Tell me just what you want most.

If you have a pal or two, write together. Sometimes team work is better than alone. But write to me at once.

—Boys' Editor.

A Steady Job for Enterprising Boys

WRITE to me. I will teach you how to sell subscriptions, supply you with samples, give you a calling list, and then send you out as a full-fledged salesman. A credit account will then be established in YOUR name. You can draw CASH from that account or get what you want in radio parts at WHOLESALE PRICES—just as you like. But in addition to this, I will give a Paragon RB2 $135.00 Receiver for first prize, a Thompson (Magnaphone) $35.00 Loud Speaker for second prize, and a N & K $8.50 Headset for third prize, to those who secure the most subscriptions between JUNE 15th and SEPTEMBER 15th. The prizes will be given in addition to what you receive for the subscriptions. If you win a prize your subscriptions will bring you cash or radio parts just the same. You are paid for your subscriptions even though you don't win a prize! That is because you will be a paid member of The Wireless Age Sales Staff!

—Boys' Editor.

Chasing Squeals

How to Get Better Results From Your Receiver

The first installment of this series of radio-trouble correctors was devoted to receiver noises; this month receiver-squeals are treated and next month the author will tell how to discover what's wrong with a "dead set" that gives no signal

By R. A. Bradley

DURING the last year or two, the public has undergone a stage of transformation or we might say reform in which time their sentiment toward Radio has become in some cases enthusiastic, in some cases tolerant and in other instances has become a radical dislike and opposition. Of this last class there seems to be two sub-divisions: those that are waiting patiently for Radio "to perfect itself," before partaking of any of its benefits—they acknowledge that there are benefits to be had from it—and then there are those who have had the misfortune to hear, in some friends home, a misguided radio set or in some radio shop where the sets are tuned by guess work or left to suffer or work out their own salvation, which incidently they never can do. To these unfortunate people, radio has presented its worst side and they have been turned against it, believing that the terrifying squeals and noises issuing from the mouth of the loud-speaker constitute a normal and ever-present condition. This is not true. To these we have dedicated this article in the hope that they will be convinced partially or totally that the foul and uncouth noises and whistles which they have heard are remediable, and not an existing condition in a properly built and properly operated receiving set. Also, this is written to aid the man who has already delved into the subject and who has bought or built a receiver and who is disappointed or is ready to give up in disgust..

Rev. Francis Duffy O'Laughlin, S.J., Ph.D., is head of the Department of Physics at Fordham University, which possesses the fine receiving equipment here shown. Father O'Laughlin teaches his classes how to tune properly to prevent squeals

IN LAST month's issue of THE WIRELESS AGE we described receiver noises, analyzing them; showing how to connect up the noises with difficulties in the receiver and in general how to eliminate them entirely. This month we are turning our attentions to another source of discomfort and annoyance—squeals. We defined noises as being anything in the form of sound which come out of the loud speaker or head phones which could not be classified as any note on the musical scale. Thus, we have brought about the definition of squeals as being sounds which were more or less musical even though they lacked harmony and seemed far away from anything which could be called musical.

SQUEALS are almost invariably due to the operation of the set, rather than to any real fault in the receiver itself. We can subdivide the squeals into three different classes. Probably the most common squeal is that due to a regenerative receiver in the hands of an inexperienced or uninformed operator. On most regenerative receivers there are two main features of adjustment, two dials which control the tuning in of a station. One of these is the wave length control which may be either a variable condenser or variometer somewhere in the secondary circuit. The other is the means of obtaining regeneration which may be the rotor coil of a variocoupler or a variometer inserted in the plate circuit. Major Armstrong some time ago discovered that if the plate circuit of a vacuum tube was tuned and brought into approximate resonance with the secondary circuit, a peculiar phenomenon took place which greatly amplified the changes in the grid voltage brought about by an incoming signal.

WHEN you tune your set, you set the wave length dial at approximately the position where a station should be received and then bring up the regeneration dial which as we said before may be the rotor of your variocoupler or a plate variometer until the signal is brought in loud and clear. We have said this is the way you do, but we should have said, this is the way you ought to do. In hunting for distant stations the inexperienced operator throws his set into a state of oscillation and then turns the wave length dial until he hits the squeal of a distant station. He then retracts his regeneration dial until the speech or music is cleared up. Much has been written on how annoying this is to neighbors who are listening in also, but the situation has not improved. When you pass over a station to which a neighbor is tuned, you set up in your neighbor's receiver a disagreeable squeal which varies in pitch from very high to very low and then up again.

A LITTLE experience in tuning your receiver will enable you to turn both the wave length dial and the regeneration dial at the same time keeping your regenerative dial at such positions that your set is at this sensitive point. It is perhaps somewhat harder to locate a distant station by this method at the start, but a little experience in tuning properly will not only make your neighbors feel more kindly toward you, but will likewise enable you to hear more distant stations. There is another source of squeal in a regenerative set and that is the gridleak. Experience has shown us that the average man slams a two megohm gridleak into his set and proceeds to forget it. Now in a good many cases two megohms is the right size gridleak for the average hard vacuum tube detector on the market today, but in as many instances or more, two megohms is not the right size for your particular tube. For example, when a regenerative receiver goes into oscillation with a plop and bang over, you can be very sure that your gridleak is of the wrong size. Then, too, as your set goes into oscillation any way or in any fashion except smoothly and gradually you can be certain that your gridleak is wrong. Very often receiving sets in a state of oscillation do not even squeal, but have a steady plop occurring at regular intervals.

This is another indication of an improper gridleak.

Rules cannot be set down for the size gridleak to be used with your set, as conditions in different sets vary with each individual tube. For instance, the writer has used a UV-200 as a regenerative detector for about three years. He has never found it necessary to use any gridleak at all. The leakage in the socket and in the mountings and in the various instruments themselves proved sufficient for the purpose. However, in the same receiver when using a UV-201A it was found impossible to get satisfactory results except with a 1½ megohm gridleak. It is well to have on hand values of ½, 1, 1½, 2, 3 and 5 megohms so that the proper size may be determined by experiment. If you have a variable gridleak that is a good one, which is not subject to temperature changes, the need for this assortment will be obviated. That finishes up gridleaks and regenerative sets.

We will next take up the squeals which are sometimes present in tuned and untuned radio frequency receivers. In a tuned R. F. receiver squeals mean one thing and that is that the means of neutralization of the stray capacities and of the interstage coupling, is out of adjustment. Whatever is the means of neutralization—mounting the transformers at angles around 54 degrees, or neutralizing condensers, they are not correctly adjusted. If your receiver is a manufactured product it should be returned for complete neutralization. If you have made it yourself there are certain methods of procedure which we will outline here. A signal should be tuned in as loud as possible, the filament turned out on the first R. F. tube leaving the tube in the socket. The first neutralizing condenser should then be adjusted, until the signal is disminished to its greatest extent. This same procedure shouid be followed with the second R. F. tube. If the neutralizing condensers are the proper size this will bring your set to complete neutralization and no further difficulties should appear. If the neutralizing condensers do not seem sufficient then attention must be paid to the angular mounting of the transformers and these transformers adjusted until complete neutralization is accomplished. If, however, you have an untuned radio frequency receiver such as the many types of reflex sets now on the market, howls or squeals in one of these means that the radio frequency amplifier is oscillating.

Don't Shout

about your receiver troubles. It's your own fault if you have them. They can all be corrected.

This is the second of a series of articles designed to show our readers how every manner of radio receiver trouble can be remedied. Last month's article was devoted to noises in your set—all kinds of noises, and told you how to get rid of them. Here you are informed how to eliminate the annoying squeals. Next month you will learn what to do when your receiver fails to give any signal at all. Make your receiver give you full value!

UNTUNED R. F. RECEIVERS

There has been a harmful theory floating around that the placing of a stage of radio frequency in front of an ordinary regenerative receiver will eliminate re-radiation. This is true only when the radio frequency amplifier is not oscillating. Radio frequency amplifiers in an oscillating condition can radiate just as powerfully and just as annoyingly as the worst regenerative receiver in existence. In most of these receivers there is a potentiometer sometimes caller "stabilizer" across the "A" battery. This potentiometer controls the negative and positive grid bias, on the radio frequency tubes. In turning this potentiometer from one extreme to the other a point is passed where the receiver is in its most critical condition, the same as a regenerative receiver. Past this point the amplifier breaks into oscillation and is quite useless and likewise harmful. The adjustment on this potentiometer varies with the wave length control, and no set position can be predetermined.

Next we come to a different variety of squeal which can be more properly termed a howl. This howl does not vary in pitch and is somewhat of a musical note, generally very, very high. The cause of this is usually in the audio frequency amplifier. There are very few shielded audio frequency transformers on the market and those that are not shielded have quite large magnetic fields surrounding them. When two such transformers are placed close together or end to end there is a coupling formed between the magnetic fields and the result is an audio frequency howl. This can be done away with by moving the transformers farther apart or by placing one at right angles to the other. If this does not eliminate it the trouble may lie in the ratio of turns in the transformer windings. You may have a low ratio in the first step and a high ratio in the second step which is the reverse of the way it should be. However, we have used as many as three stages of audio frequency amplification employing high ratio transformers in all three steps and placing across the secondary terminals of each transformer a 1-10th megohm leak.

This leak cuts out all "set noises" and squeals which were present when the leak was not employed. It was also found that by shunting the secondary of each transformer with an .001 mfd. fixed condenser in place of the gridleak the same result was brought about. We do not advise, however, the use of more than two stages of audio frequency amplification.

We mentioned in a previous paragraph how your set might be manipulated to the annoyance of your neighbors, but we did not mention what to do in case your neighbor annoyed you for the very good reason that we don't know. The best thing that we can offer in this instance is to locate the offender and show him how to tune his set. There is one source of squeal which may be in most any set and which comes under none of the previous headings and that is the one which is due to too high filament current. This is probably more noticeable with dry cell than with storage battery tubes. We know of several owners of radio sets who when they turn the set on whirl the rheostats clear over to the limit in order to get more "noise" out of the set, and that is exactly what they get.

(Continued on page 82)

Continuing a Summary of the Entire Subject of Amplifiers

Amplifiers

With proper design great amplification can be obtained in several ways without distortion

By Louis Frank

PART II

Multi-Stage Amplifiers
Resistance Coupled:—Audio and radio frequency.
Impedance coupled amplifiers:—Choke Coils.

Part III will follow in next issue

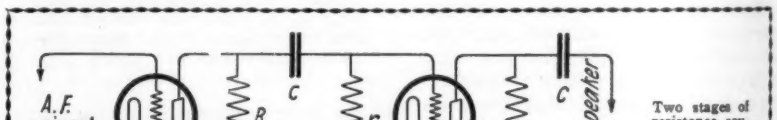
IN the first part of this article published in the May, 1924, issue of THE WIRELESS AGE we considered the cases where a single tube amplified the energy input. When a number of tubes are placed in cascade, the amplified output being still further amplified by the succeeding tubes, we have a multi-stage amplifier. Assuming properly designed circuits, enormous amplifications may be secured. For supposing each tube and its circuit gave an actual amplification of 10 times, the received signal would be amplified 10 times by the first tube, the second tube would amplify this increased signal 10 times more, making an amplification of 100 and so on. The great possibilities of multi-stage amplifiers becomes apparent.

In the multi-stage amplifiers any of the systems described for single stage amplifiers may be used. Thus we may have multi-stage resistance, inductance, transformer and tuned circuit amplifiers. These in turn may be used for either radio or audio frequency amplification, and the design will depend upon which is used. In many cases it will be found that the radio frequency amplifier is more difficult to build for reasons which will appear later. But the radio frequency amplifier has some important advantages. In the first place it should be observed that the detecting action of vacuum tubes is proportional to the square of the radio frequency voltage applied to it. Hence a radio frequency amplifier which will increase the magnitude of the radio frequency voltage before it is applied to the detector tube will be of great assistance in increasing signal intensity. Radio frequency amplification of one sort or another is quite essential for long distance reception, in order that the very weak radio frequency signal may be amplified sufficiently to actuate the detector tube efficiently. On the other hand, audio frequency amplification will be found to be essential if loud speaker operation is to be secured. The limiting features of both these types of amplifiers will be described in the course of the article.

Radio Frequency amplification brings distance

MULTI-STAGE RESISTANCE COUPLED AMPLIFIERS—AUDIO FREQUENCY

A two-stage resistance coupled audio frequency amplifier is shown in figure 1. By adding more tubes in the same way this may be made a three-stage, or any numbered stage amplifier. The audio frequency signal to be amplified is applied to the grid of the first tube. This audio voltage is repeated in the plate circuit of the first tube and an amplified voltage appears across the plate resistance R. This amplified voltage is then applied to the grid of the second tube through the grid condenser C1, and the voltage amplified still further by the second tube, and so on.



Two stages of resistance coupled audio frequency amplification showing how the resistances are connected in the circuit.

In each case it will be observed that a grid condenser is necessary even though rectification and detection are not the objects of the tubes. The reason for the grid condensers is to prevent the high positive potential of the plate battery from being impressed on the grids of the tubes through the plate resistances, thus avoiding damaging the tubes. Such a condenser is called an "isolation" condenser, it isolates the grid from the plate battery supply. Since these grid condensers are required it also becomes necessary to use grid leaks (r). For unless these are used the negative charge accumulating on the grids will have no means of escape, and will thus reduce the plate currents to zero and block the operation of the tubes. As soon as one step or a multi-stage amplifier is blocked the entire amplifier becomes inoperative. The grid leak functions in discharging this negative potential, thus permitting the operation of the amplifier.

The values of plate resistances required in multi-stage amplifiers are determined by exactly the same conditions as for the single stage amplifier described in the May issue. For practical results the plate resistances should be several times the internal impedance of the tube. Since the tubes used in a multi-stage amplifier are usually alike the plate coupling resistances used for the different stages are also the same.

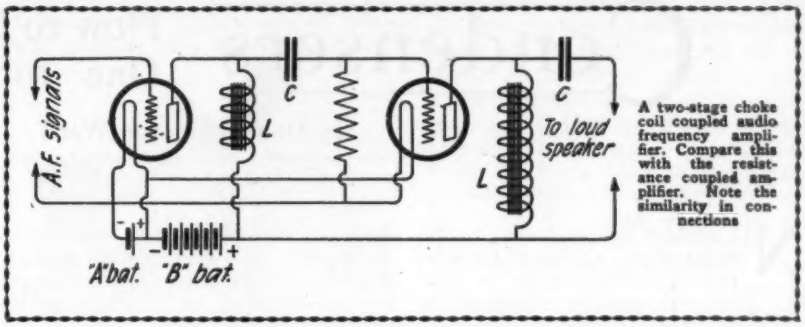
Inasmuch as the plate impedance of amplifying tubes as designed today is of the order of 20,000 ohms, the plate coupling resistances used should be about 60,000 ohms or over. These resistances must satisfy certain conditions if good results are to be secured. In the first place, the design of the resistances must be such as to have a minimum distributed capacity. For since this distributed capacity is in parallel with the resistance itself, it will result in reducing the impedance of the coupling resistance, and hence also in reducing the amplification. In the second place the plate coupling resistance carries the entire plate current. It must therefore be able to handle the amount of energy dissipated in it without overheating and changing its resistance. For the change in resistance will again result in alteration of the amplification. But worse than that, if the resistance alters regularly

with the passage of current through it, there will simultaneously result a change in current through the resistance, with the bad feature that noises will be heard in the phones. Crackling, hissing and irregular noises are often due to poor plate resistances which vary in magnitude. The standard tubular resistances and lavite resistances have proved to be satisfactory for this work.

The proper values for the grid condensers and leaks are determined by definite considerations. If figure 1 is examined it will be seen that the grid circuit of the second tube is in parallel with the plate coupling resistance of the previous tube between points A and B. The impedance of the entire grid circuit must therefore be much greater than that of the plate resistance in order that the amplification be not influenced. The impedance of the grid circuit is determined by (1) the impedance of the internal grid-filament path of the second tube, and (2) by the impedance of the grid condenser and leak circuit. The impedance of the grid-filament path inside the tube is determined by its capacity and resistance. In general, as tubes are made today, its capacity is so low as to make its reactance greater than a million ohms at speech frequencies, and its resistance is of the order of a few hundred thousand ohms. Hence the impedance of the grid-filament path of the tube is seen to be sufficiently great not to influence the amplification at audio frequencies. The impedance of the grid leak circuit is dependent on the leak mostly. This is usually of the order of a few million ohms, and hence will have no effect on the plate resistance and amplification. Since the voltage across the plate resistance R is applied to the grid of the succeeding amplifier tube through the grid condenser C, the reactance of this grid condenser must be so low compared to the plate resistance that it does not alter the voltage applied to the grid, for any voltage consumed by this condenser means that much less to be amplified by the succeeding tube. Reasonable values for this condenser are found in practice to be about 0.1 to 1 microfarad, the larger the better. Thus for a 1 microfarad condenser the reactance at 1,000 cycles is about 160 ohms, which is seen to be negligible compared to the 60,000 ohms for the plate resistance R, and therefore there will be no voltage lost in this condenser.

Resistance coupled amplifiers distortionless

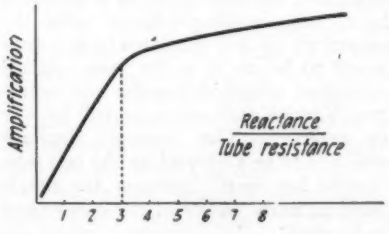
The disadvantages of the resistance coupled amplifier were explained in the first part of this article. The resistance coupled amplifier has, however, one very great advantage for broadcast purposes. It gives uniform amplification over the entire audio frequency range, hence it is a distortionless amplifier. It gives better quality speech and music than most any other type of amplifier.



A two-stage choke coil coupled audio frequency amplifier. Compare this with the resistance coupled amplifier. Note the similarity in connections

RADIO FREQUENCY

The same type of circuit and the same considerations apply for radio frequency amplifiers as for audio frequency amplifiers. But there is one great difficulty with radio frequency resistance coupled amplifiers at low wave lengths. The impedance of the grid-filament path of the tube is so low that it practically short circuits the plate coupling resistance, and hence destroys all amplification. To illustrate with a numerical example, suppose that the plate resistance R in figure 1 is 60,000 ohms. In present day tubes the tube capacity is of the order of .000010 microfarad, and at 300 meters the reactance is about 16,000 ohms. These 16,000 ohms are in parallel with 60,000 ohms plate coupling resistance, and therefore the effective plate impedance is decreased to less than 16,000 ohms with the result that amplification is considerably reduced. This effect is greater as the wave length decreases. Thus resistance coupled amplification at low wave lengths is not feasible. At the high wave lengths it becomes more possible because the reactance of the tube capacity is not so low. It is therefore recommended that this type of amplification should not be used at radio frequencies at the broadcast or amateur wave lengths.



Graphic picture of the amplifying action of the vacuum tube

MULTI-STAGE IMPEDANCE COUPLED AMPLIFIERS—AUDIO FREQUENCY

A two-stage audio frequency amplifier, inductance coupled, is illustrated in figure 2. It is similar in appearance to the resistance coupled amplifier previously described, the only difference being that iron cored inductances are used in place of resistances to couple the different stages together. The grid isolation condenser and the grid leak should have the same values as for the resistance coupled amplifier mentioned above.

The amplification obtained with such a system depends upon a number of factors. In the first place it depends upon the value of the choke coil or inductance. Figure 3 is a curve which shows how the amplification depends upon the reactance of the inductance and it is seen that practically maximum amplification is secured when the reactance is about three times the internal resistance of the tube. Hence the iron core choke must be made large enough to give this value, when full amplification is had. Now the reactance of the inductance depends upon the frequency. Therefore, in the second place, the amplification depends upon the frequency. The reactance of an iron core inductance increases with frequency, therefore at the lowest frequencies it is possible that the reactance may be much lower than is required to give full amplification. At the higher frequencies the reactance will be greater, hence full amplification will be secured at the higher frequencies. Thus we will have non-uniform amplification of the low and high frequencies, which is bad for it introduces distortion.

This is largely the trouble with all audio frequency choke coil amplifiers; unless they are properly built they readily distort. This may be avoided, however, by a consideration of the principles here outlined. If the inductance is made sufficiently great so that its reactance at the lowest audible frequency, say 50 cycles, is about three

(*Continued on page 86*)

Condensers

How to Choose the Right One for Your Circuit

By Donald Gordon Ward
Associate Member, Institute of Radio Engineers

PART 1

NO attempt will be made in this series of two articles on the subject of condensers to say that any particular variable condenser is any better than any other variable condenser, but on the other hand the various factors which enter into the construction of a condenser will be pointed out and it will be then left to the individual purchaser as to the make of condenser which he will choose.

Any attempt to point out the very best type of variable condenser on the market and then to say that only this condenser should be used would lay the one who had made the statement open to a great deal of ridicule, for as there are all grades of condensers on the market at the present time so are there all types of construction in radio receivers. We have variable condensers which are subject to many defects not present in the best grade of condensers and so there are many receiving sets which have defects not present in other receivers. It would be a foolish waste of money to put a variable condenser of the best grade of construction and having the smallest amount of losses into a receiving set that had poorly constructed coils and was wired in a haphazard fashion and also it would be a senseless procedure to burden a finely constructed receiver with a variable condenser which has a large number of losses of various kinds.

Therefore after the reader has decided to construct a receiver let him then decide just about how much money he has to put into a receiver and then he will be better able to decide just what he should purchase in the line of condensers for his outfit.

In this the first of the series of two articles on condensers no attempt will be made to give any exact data on condensers, but more attention will be given to pointing out the general condenser principles while the second article of the series will treat with some of the more exact condenser details which must be taken into consideration when one wishes to be extremely precise and accurate in his receiver construction in order to have, as a finished product, a receiving set which is as fine a one as he can construct. One very excellent measure of the quality of a condenser lies in its price, for the rule holds true in radio as well as in any other. that the purchaser gets just about what he pays for, and while there are occasionally real bargains in radio parts, most generally if one pays a small price for a piece of apparatus he gets something which is only worth what he pays for it, and even sometimes he does not even get as much as that, because even though to the average broadcast fan a variable condenser looks like a variable condenser, mere looks does not enable the purchaser to judge as to the working qualities of his purchase.

NOTE SOLID END PLATES
NOTE HEAVY PLATES NO LIKELIHOOD OF WARPING
ACCURATELY MILLED SPACERS, NOT MERELY STAMPED, BOTH ON ROTARY AND FIXED PLATES.

RANGE OF CAPACITY IS IMPORTANT

One of the first determining factors which concerns the home radio constructor is the capacity of a condenser. What is its maximum capacity and what is its minimum capacity? There are two elements which enter into the construction of the radio frequency circuit, and capacity is one of them. Even if the amateur constructor does not know how to calculate the wavelength of his circuit from the inductance and capacity which it is going to have, still he should know what the capacities of his condensers are supposed to be, as it is the range of his capacities which determine the wavelength range over which he will be able to receive. The average diagram which is to be followed by the one who "builds his own" contains the maximum capacity values of the condensers to be used.

A practice that has been followed in the past and is still being followed by some manufacturers is to classify their condensers according to the number of plates in the condenser, but that is no indication of the electrical dimensions of the condenser, which is what one really wants to know. For example, there are two condensers lying at the right hand of the author while he is writing this article. They are both of the so-called 23-plate variety and the capacity of one is almost double the capacity of the other, yet according to the number of plates used they are exact duplicates. The root of this trouble lies in the fact that a great number of condensers are made by concerns who have simply taken a variable condenser and copied it without any regard to its electrical dimensions, probably for the very sufficient reason that they themselves do not know the meaning of capacity and its effect in electrical circuits, but of course in time they will learn and gradually their products will improve in quality and then they will mark their condensers with their electrical values. This will not come, however, in many cases until the public begins to demand that the capacity of condensers be noted on the condenser as is the case in the better grade of apparatus.

It is not an expensive procedure for the manufacturer to do this, and does not work any hardship upon him, while on the other hand it does tell the constructor definitely whether that particular condenser will fulfill his demands or not.

NUMBER OF PLATES MEANS LITTLE

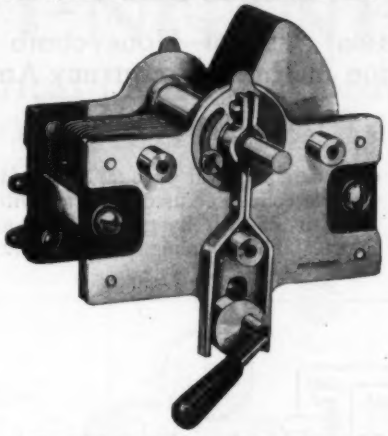
This matter of the public merely designating a variable condenser according to the number of plates it employs may be exactly compared to the man who, wishing to purchase a suit of clothes, walks into the nearest clothing store and says that he wants a blue suit. The clerk hands him the first blue suit without looking at the size of the suit and the man merely says, "Wrap it up." He would make a sorry sight to say the least if he had purchased a suit of clothes which was made for a man of greater size than himself, but he would not look any worse than would his radio set, if he should buy a variable condenser of any old size, electrically speaking. It must be remembered that there is no relationship between the electrical and mechanical dimensions of a variable condenser, and that while two condensers may have the same number of plates and these plates may be of the same size, yet if the spacing between the plates differs by even a slight amount, such as a hundredth of an inch, the capacity will be radically affected.

Another dimension which is just as necessary to have upon a variable condenser as its maximum capacity, is its

minimum capacity, for it is the minimum capacity value of the condenser which determines the minimum wavelength to which the circuit will tune. It is the usual practice for one who wants a circuit that will go down to the lower wavelengths used in broadcasting to purchase a small sized variable condenser. Suppose for example that the maximum capacity is known to be .0005 microfarad. What does this tell about the minimum wavelength to which this circuit will tune? Absolutely nothing. For the minimum wavelength is dependent upon its minimum capacity which should not be greater than 10 per cent. of its maximum capacity in a properly constructed condenser, but which very often will run as high as 20 per cent.

Minimum and Maximum Capacity Relation

A condenser with the 10 per cent. minimum will permit the circuit to be tuned down to approximately half the wavelength value which may be reached by the circuit having a condenser of 20 per cent. minimum. The following table of three sets of values was made of three condensers of different makes and illustrates the difference in electrical dimensions.



Grounded rotor, brass plate condenser

Max. Cap.	Min. Cap.	Per Cent. Min. of Max. (approx.)
.002	.00006	3
.0005	.0001	20
.00035	.000018	5

As will be seen from these figures the first condenser with its very high maximum of four times that of the second condenser will be able to reach a lower wavelength than the second condenser if both condensers are employed with the same coil of inductance. And in addition to this, the upper wavelength limit of the circuit will be four times as high when using the .002 mfd. condenser as compared to a circuit with the same value of inductance, but using the condenser which has a maximum capacity of .0005 mfd.

Therefore when about to purchase a variable condenser for the radio receiver, decide about how much you are able to spend for your whole receiver and allot to condensers their proportionate part of the entire amount so that all of the apparatus will be of at least approximately the same grade and so that nothing will seem out of place either mechanically or electrically. Then select your condensers with a regard to their electrical dimensions, about which more will be said in the second part of this article.

Selecting Loud Speakers

(*Continued from page 33*)

selections will sound noisy and will have a drumming quality.

2. The loud speaker fails to reproduce low pitched notes, but does respond to high pitched notes. Speech will will be fairly intelligible on such loud speakers, but the piano will sound thin and much like a harp or guitar. Bass voices will be weak or else sound like thin baritones. The effect in the rendition of orchestral selections will be feeble and squeaky, and without "body" and roundness. The accompaniment of the 'cellos and violins, and other deep-voiced instruments will be lost. The general effect will be that of a cheap and poorly designed portable phonograph with a small horn.

3. The loud speaker may reproduce only notes in the middle register, dropping out high and low pitched notes. This is unfortunately a fairly common fault. While speech is moderately intelligible on some examples of this class of instruments, music is very unmercifully treated, and the faults found are a combination of those mentioned in 1 and 2 above.

4. Loud speakers should not rattle on the loudest notes which are produced; but the user should be cautious in drawing conclusions since he may be overloading his radiotrons by excessively loud signals, combined with low plate voltage and incorrect grid bias. Unless the listener is sure the radiotrons are not themselves being "saturated" or overloaded, he should not blame the loud speaker for rattling noises. The best way of checking up on this point is by trying a known reliable loud speaker on the set in place of the suspected one.

5. Loud speakers occasionally are insensitive; that is, they fail to respond to weak signals at all, and do not give a good response to reasonably loud signals. The only test is by comparison with standard makes. The objection to insensitive loud speakers is the necessity for overloading the radiotrons to get a loud signal.

6. Some loud speakers, while otherwise fairly satisfactory, reproduce combinations of instruments — voice and piano, or violin and piano—less satisfactorily than solo efforts. This fault requires for proof of its existence a careful listening test on a suitable selection from a broadcasting station of repeatedly proven high quality.

It is not implied that the above rough listening tests are an effective substitute for a precision laboratory test of a loud speaker under properly controlled conditions. Conclusions badly in error may sometimes be drawn from a single unsuitable listening test with the loud speaker fed from an unreliable broadcasting station or from an unsuitable receiving set, yet the preceding suggestions do give a general idea of the defects of some loud speakers.

It may be justly said that radio broadcast reception stands or falls in large part on the merits or defects of the loud speaker, since it is this device which finally produces the desired entertainment. It is therefore regrettable that so many inferior articles of this type have been placed on the market by self-styled "experts" who were actually lamentably ignorant of the requirements of the problem. The influence of such loud speakers on the reputation of radio reception has been undesirable. Fortunately quantitative tests and exact design methods are now available, and suitable loud speakers can be obtained. Continued improvement in these devices may also be confidently expected until it will become nearly impossible to distinguish between loud speaker output and the original studio rendition of a musical selection.

Radio Frequency Circuits

The Practical Use of Honeycomb Coils and Regeneration in Radio Frequency Amplification

By Henry Baron

THE writer has tried out quite a number of radio frequency amplifier circuits and has thought that possibly some of the results obtained from actual practice might be of value to the radio man who builds his own apparatus. There are a number of peculiar things that happen in radio-frequency sets which are not met with in the ordinary detector and two-step or simple detector outfits.

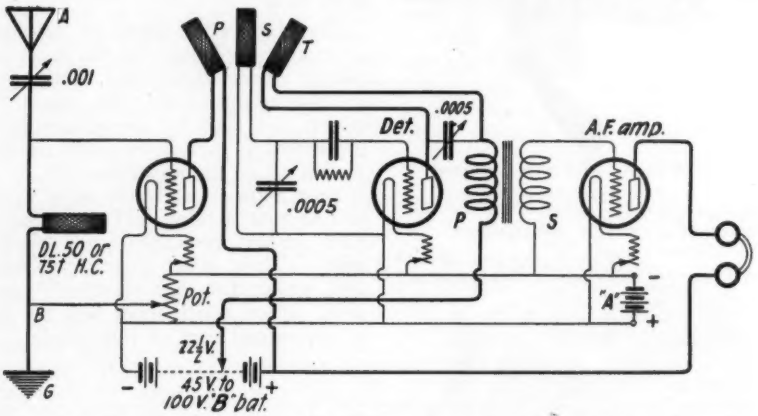


Figure 1—Hook-up of one step of radio frequency, detector and one step of audio frequency amplification

Radio-Frequency With Honeycomb Coils

Figure 1 shows a circuit which several friends of mine have been using for a year or more and which I have also tried out. This circuit provides one stage of inductively coupled radio-frequency amplification, and one stage of audio-frequency amplification. A second stage of audio-frequency can be added to operate the loudspeaker when desired. Referring to the diagram, it will be seen that a loop shunted by a .001 mfd. variable condenser, preferably of the vernier type, may be shunted across the grid and filament circuit at A and B, or else an outdoor antenna used with a .001 mfd. variable condenser used in series with a 50 or 75-turn honeycomb coil, as shown. The coupling and regeneration are taken care of by three honeycomb coils used in a regular three-coil mount provided with gears, or simply with knobs, utilizing a 50-turn honeycomb coil for the primary, a 50-turn coil for the secondary, and a 35 or 50-turn coil for the tickler.

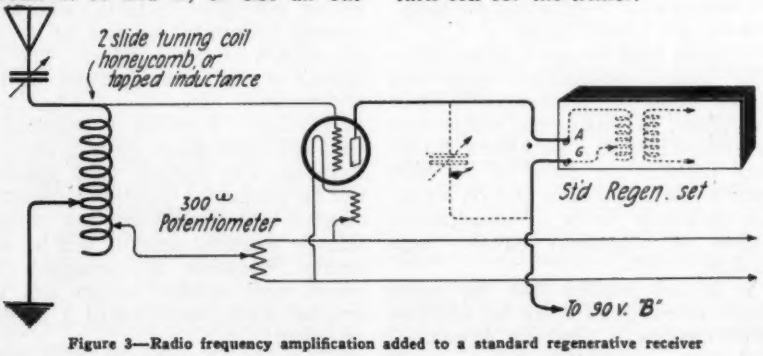


Figure 3—Radio frequency amplification added to a standard regenerative receiver

There are several different arrangements of this circuit which have been published and tried out; for instance a variable condenser of the 23 or 43-plate type may be used across the primary coil, but this set works very well with a .0005 mfd. variable condenser connected across the secondary, and a similar variable condenser connected across the tickler. The latter should of course be of the vernier type, as this control is very critical. If but one stage of audio-frequency is used, as indicated at figure 1, then the audio frequency transformer utilized should have a fairly high ratio, say 5 or 6 to 1, and it will be found the most satisfactory to purchase a good sized transformer, and not a small one for this stage, or in fact for any successive stages. The large sized transformers, several of which are now available on the market, have a lower resistance for one thing than the smaller transformers, and owing to the greater quantity of large sized copper wire used in winding the primary and secondary coils, together with the lower flux density in the iron core, the operating efficiency is improved all around,

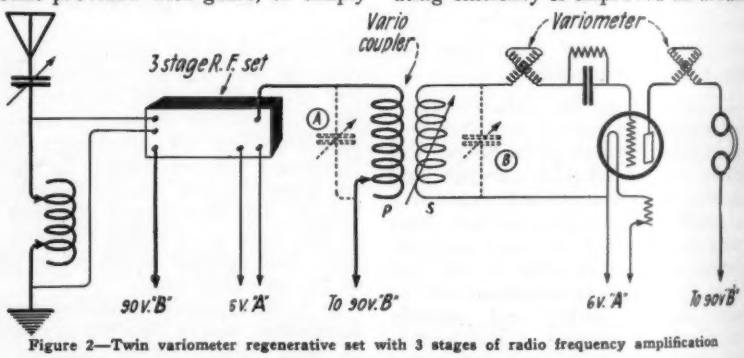


Figure 2—Twin variometer regenerative set with 3 stages of radio frequency amplification

and these large transformers selling for $6.00 or $7.00 are certainly a fine investment and one that you will never regret. There is a great deal of talk nowadays about using decreasing ratios between the windings and the transformers for the different ratios, that is, a higher ratio in the first stage and a lower ratio in the second stage, but some of the best commercial sets being turned out today utilize two of the large audio frequency transformers just mentioned, with identical ratios, and they certainly do deliver the goods. The writer at present is using two Schermatron transformers of the same ratio, and they leave nothing to be desired. A potentiometer of 200 to 300

(*Continued on page* 84)

RADIO ENGINEERING

An Experimental Home-Laboratory Course in Simple and Advanced Radio Design

By John R. Meagher

Vacuum Tubes

AS the main purpose of this course is to summarize and to some extent supplement the textbook study and experimental work of the student, this and succeeding chapters on vacuum tube operation should be read only after the subject has been studied in the textbooks recommended at the beginning of the course. In fact it would be well for the student to gather together and carefully study all available data on tubes. If Professor Morecroft's *Principles of Radio Communication* can be secured read the section between pages 364 and 577.

From our text books we should have found that a vacuum tube—or better termed—a triode—as used in radio communication has three elements: a filament, a metallic plate surrounding the filament and a grid or wire mesh interposed between the filament and plate.

When the filament is heated—generally by an electric current—it emits negative electrons which may be attracted to the plate if the latter is charged positively with respect to the filament. The quantity of electrons emitted from the filament depends mainly upon the temperature and structure of the filament; secondarily upon the charge surrounding the filament.

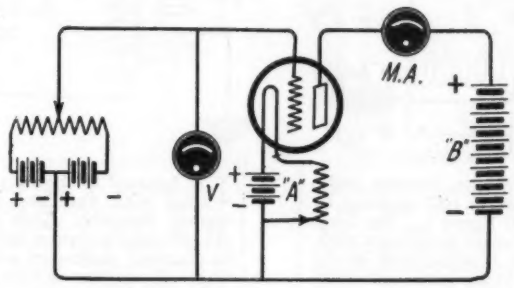
The quantity of electrons reaching the plate depends upon the difference in voltage between the plate and filament and upon the space charge, or charge in the space between these electrodes. If the space charge is negative—with respect to the filament—the electrons from the filament will be repelled and most of them will fall back upon the filament. If the space charge is positive, the flow of electrons from the filament to the plate will be increased.

Control of the space charge is the purpose of the grid; as its voltage varies, the space charge varies in exact accordance and the electronic flow and plate current change correspondingly. If the grid voltage varies at a radio frequency the plate current will vary at a radio frequency; if the grid voltage varies at an audio frequency the plate current will vary at an audio frequency.

The relationship between the grid voltage and the plate current is the most important factor in vacuum tube operation.

This relationship is generally graphically represented with a grid-plate characteristic curve. The measurements from which the curves may be drawn may be secured experimentally for any tube with a testing circuit similar to the diagram.

Here a vacuum tube is arranged with suitable A and B (filament and plate) batteries and a special C (grid) battery that may be adjusted to maintain the grid at any desired



negative or positive voltage with respect to the negative terminal of the filament. A grid circuit voltmeter to show the voltage difference between the grid and the negative terminal of the filament, and a plate current ammeter to register the current in the plate circuit, are necessary to obtain the desired measurements.

In using such a testing circuit, the filament and plate battery voltages are kept constant for any one curve. The grid voltage is made negative to a value where the plate current is zero and then, advancing the grid voltage in steps toward zero and positive values, readings are noted of the plate current values corresponding to each step in grid voltage. The upper limit of grid voltage is usually restricted to that value where further increase does not increase the plate current.

Grid voltages and corresponding plate current values for an assumed case of a small tube are given here:

Grid Voltage	Plate Current	Grid Voltage	Plate Current
—6	0.00	3	1.50
—5	0.01	4	1.65
—4	0.10	5	1.90
—3	0.20	6	2.10
—2	0.35	7	2.20
—1	0.55	8	2.28
0	0.75	9	2.32
1	1.00	10	2.35
2	1.25	11	2.37

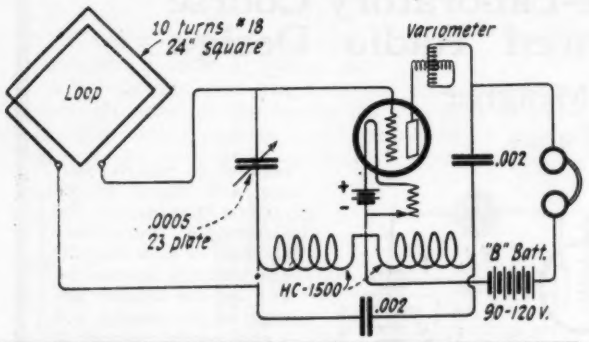
The student may make up a curve from these figures. Secure a piece of cross-section or graph paper and along the left hand vertical line mark off units of plate current; say one square to represent one-tenth of a milliampere. Then along the horizontal bottom line mark units of grid voltage, say one volt to a square, starting at the left with —6 and going as many squares to the right as necessary to number up to positive 11. Then on the minus 5 line make a dot up 1/10 of the first .1 milliampere square to correspond to .01 milliampere; the value of plate current when the grid is —5. Do the same with all the other grid voltage-plate current combinations and after all the dots have been plotted, connect them together with a smooth curve. This should look similar to those shown in textbooks if drawn corrrectly.

Now that we have the grid voltage-plate current curve, what are we going to do with it? For one thing we can see how the vacuum tube operates as an amplifier.

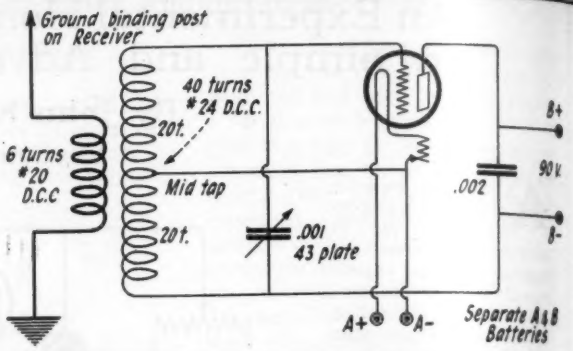
(To be continued.)

THIS Course of Instruction in Radio Engineering commenced with the February issue of The Wireless Age. In that issue the author described a simple home laboratory layout of apparatus which students could make up at small cost. This apparatus was designed to enable the student to experiment for himself along the lines suggested by the author, so that by carefully following the course students may really learn Radio. In subsequent issues were presented first some elementary instruction about circuits, then two chapters on inter-tube coupling, including the study of impedance, grid-leaks, resistance coupling and transformers, which brings the student next to a study of the operation of vacuum tubes, the subject of the present chapter. The author recommended the use of supplementary text books, particularly one by E. E. Bucher entitled "Wireless Experimenter's Manual."

Selected Radio Hook-Ups



FROM the number of requests which we receive daily we gather that the one tube super is still popular as ever. Diagram of this set is shown in figure 1. The loop is tuned with a 23 plate variable condenser preferably with some means of vernier adjustment. A Hammarlund would be particularly fitting here. The two honeycomb coils 1500 turns each are a necessary part of the circuit.



IN figure 2 is shown an external oscillator which can be used with excellent results with most any radio frequency receiver. This oscillator consists of 40 turns of No. 24 double cotton covered wire wound on a three inch in diameter cardboard tube. Three eighths of an inch from this coil another winding is placed consisting of six turns of No. 20 double cotton covered wire.

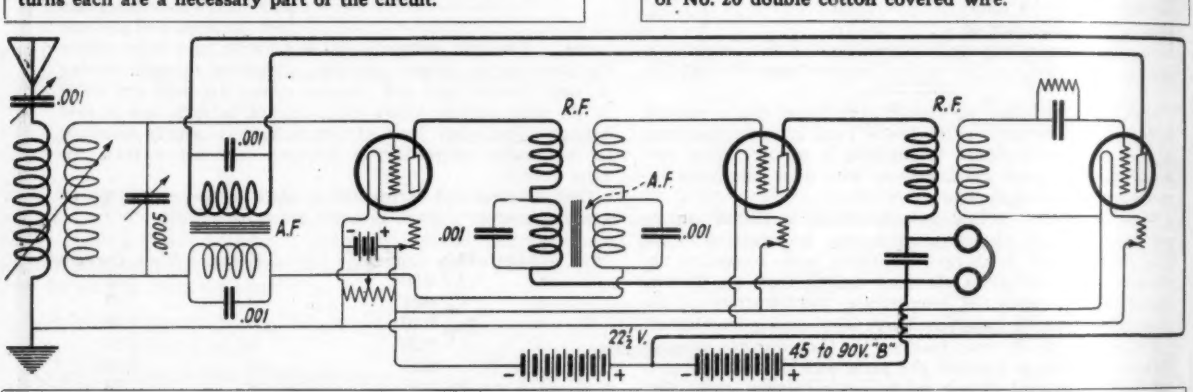
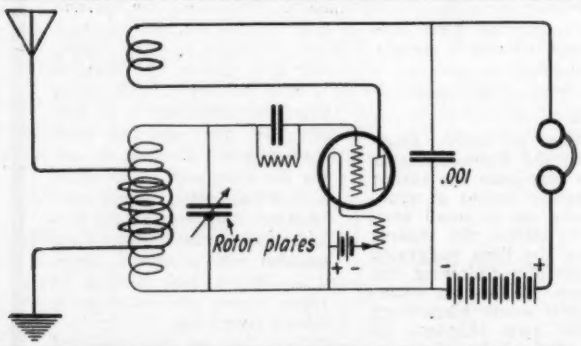
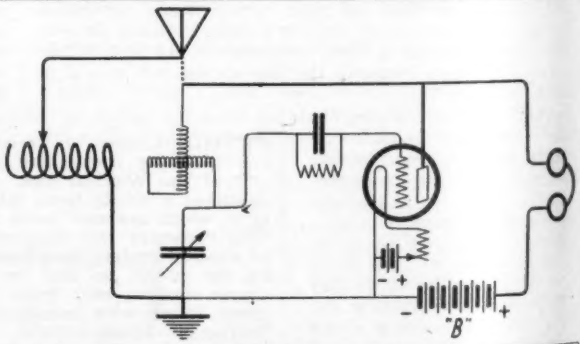


FIGURE 3 shows the ever popular Grimes Inverse Duplex Receiver. The diagram is clear and explains itself. This is a rather difficult set to get into operation and satisfactory working conditions but is nevertheless an interesting one to experiment with. The set consists of three tubes two of which perform as radio and audio frequency amplifiers. It differs from ordinary reflex in that the first stage audio is reflexed back in the second stage of radio and the second stage of audio is reflexed back into the first stage of radio. This arrangement provides for better balance in the work of each tube and prevents overworking any one particular tube. The main tuning unit consists of a variocoupler whose secondary is tuned by a 23 plate variable condenser. A 43 plate condenser is inserted in the antenna lead.

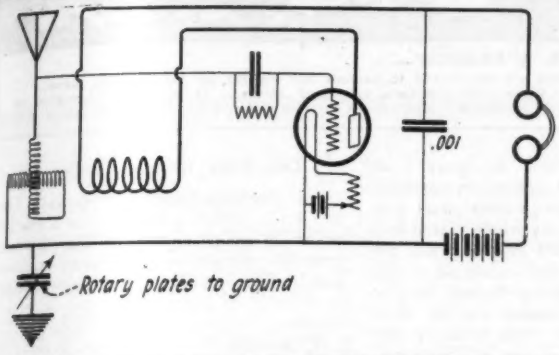


WE still have with us too many of the old standby. We have shown how the single circuit tuner may be changed to a three circuit arrangement which will greatly enhance its selectivity. In figure 4-A the antenna and ground are disconnected from their original positions and connected to the two ends of six turns of windings placed directly over the original windings on the stationary coil.

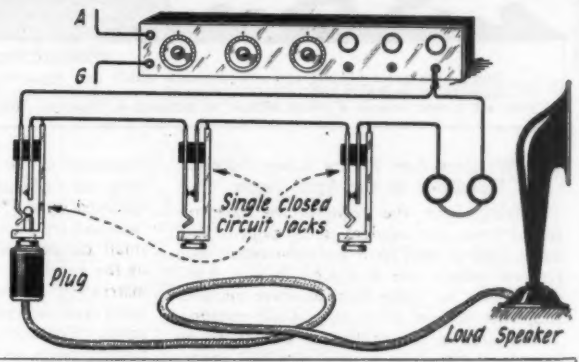


IN figure 4-B the Colpitts' oscillator circuit, one of the worst tuners in creation, is changed to an inductively coupled set. The antenna is tuned by means of a 35 turn coil wound on to a three inch tube and tapped every 5 turns. In winding this coil use large wire, preferably No. 20. This makes the tuner an inductively coupled circuit with a tuned primary.

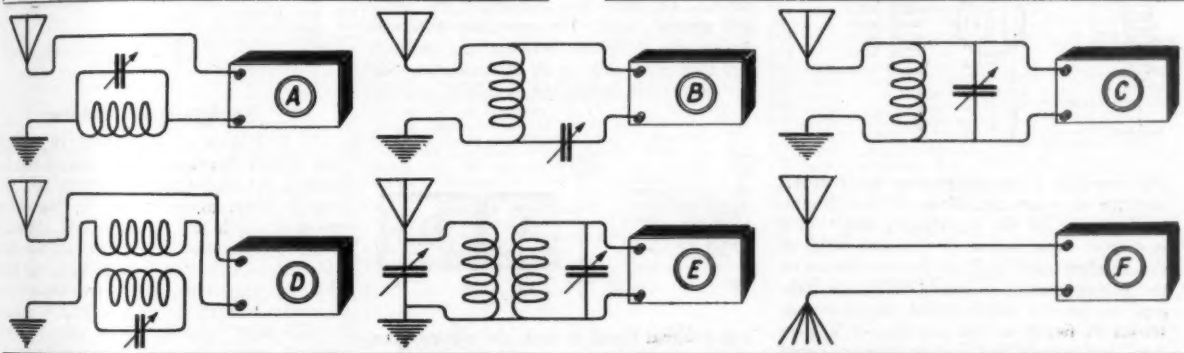
For the Home Builder



A MAN came into our office and told us that he had heard Frisco on the set hooked up according to the diagram in figure 5. We were skeptical as usual so we were invited out to hear it for ourselves. We didn't hear it but we heard nearly every other station this side of the Rocky Mountains. It combines tickler and tuned plate feed back in obtaining regeneration.

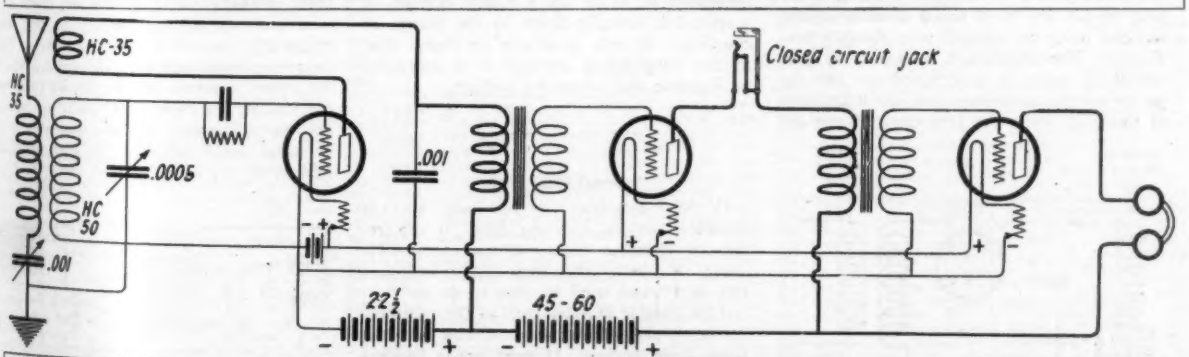


IN figure 6 we have shown an arrangement that will provide loud speaker connections for your receiver in each room of the house. The phone jacks are placed in the mounting similarly to the wall plugs carrying the house lighting in the modern house and a single closed circuit for jacks. By using this type jack any number of loud speakers can be connected into the phone circuit.



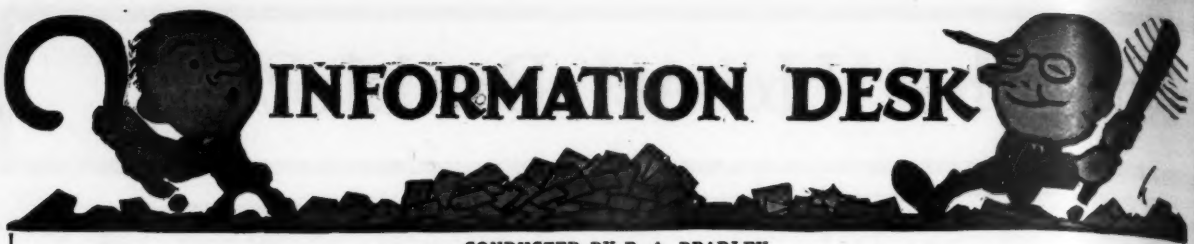
IN figure 7 we have shown six ways of eliminating interference and sharpening your tuning. The first five are developments of the wave trap and the sixth is the use of a counterpoise instead of a ground. In each of the trap circuits the coil is a 50-turn honeycomb coil and the tuning condenser a 23 plate .0005 mfd. The counterpoise system shown in figure F is generally the last resort when a receiver is located very close to one or two powerful broadcasting stations. The counterpoise consists of one to four wires the same length as the aerial and insulated the same, placed between the aerial and ground, from thirty to forty feet below the antenna.

A connection is then made from the counterpoise to the ground binding post on your set.



WE STILL have requests for the popular old standby, the three honeycomb coil detector and two step receiver. This is shown in figure 8. You will note that there is no jack provided for plugging in on the detector tube. The practice of omitting this jack is becoming more pronounced as people realize that when a signal is tuned in with the phones in the detector jack it very often is not there when the phones are plugged in the first or second step due to the difference in impedance which the phones offer with respect to the primary winding of the first audio frequency transformer.

We ask our readers in requesting hook-ups and circuit diagrams for a particular type of receiver to look through our back issues before writing us.

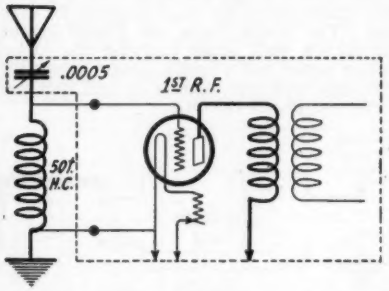


CONDUCTED BY R. A. BRADLEY

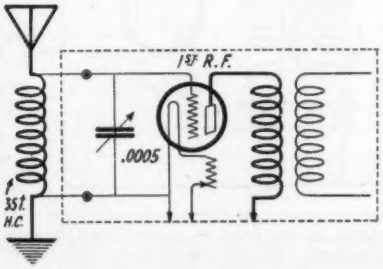
Due to the great volume of correspondence which this department entails we are forced to remind our readers on the following points: Be sure to enclose a self-addressed stamped envelope with your letter. Make your questions clear and concise. If you wish information on your set please enclose a rough sketch or hook-up if possible. Do not ask us to make comparisons between different makes of apparatus or sets.

The Wireless Age Reflex Loop Receiver Described in the April Issue

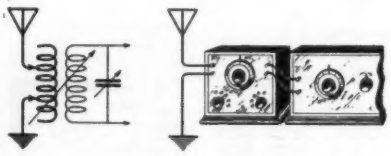
Judging from the requests we have received from our readers, it is evident that many persons who have built the reflex loop receiver which was described in our April issue, wish to make this sensitive receiver adaptable to use with an outside antenna. When such a set as this is used with an outside antenna the results obtained gener-



ally resemble a boarding-house hash of all stations at once regardless of the frantic manipulation of the wavelength dial. This is due to some extent to the sensitivity of the receiver and also to the resistance of the tuning circuit which in this case happens to be the conventional single circuit shown in figure 1, and consists of a fifty turn honeycomb coil or variometer tuned by means of a series or shunt condenser. In figure 1, the antenna circuit is really the only tuned circuit in the whole receiver, while the grid circuit of the first radio frequency tube which should be sharply tuned is in reality fixed at the frequency of the coil. In figure 2, the antenna circuit and the grid circuit are both tuned simultaneously, but can never be brought into absolute resonance. The wavelength to which the grid circuit is tuned is determined by the capacity of the condenser and the inductance of the coil, while the frequency of the an-



tenna circuit is dependent on these things and also the added inductance and capacity in the antenna and ground systems. So it will be readily seen that to have maximum selectivity it is necessary to tune these two circuits independently and bring them into resonance in this fashion. In figure 3 we have an ordinary 180 degree variocoupler mounted on a 7"x7" hard rubber panel with taps and tap switches, the whole placed in a small cabinet and placed near the left end of the receiver. The four terminals of this instrument are brought out to four binding posts conveniently arranged on the front panel. Connections are made from the two binding posts on the receiver, to which previously were connected the two leads from the loop antenna, now to the binding posts on the right hand end of the variocoupler panel. From these two posts two leads run to the secondary of the coupler. The wires from the two tap switches run to the two binding posts on the left of the coupler panel. To these are connected the aerial and ground leads. In operating this new device the coupling between the primary and secondary coils is set at maximum, that is, with their respective windings parallel



and a signal tuned in with the variable condenser on the receiver. The tap switches are now adjusted for maximum intensity. Now using one hand to vary the setting of the condenser and the other to vary the coupling dial gradually reduce the coupling between the coils and at the same time readjust the setting of the condenser dial if necessary to make up for any change in wavelength brought about by the change in coupling. It will generally be found that as the coupling is reduced it is necessary to increase the condenser setting.

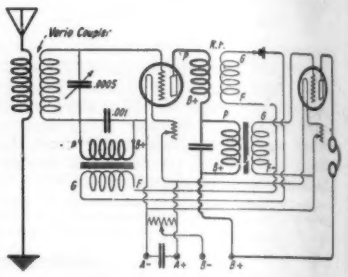
Generator Hum

C. W. Engelder of Norfolk, Va., is troubled with a constant hum in the receivers whenever his set is turned on. He says: "Evidently this hum cannot be tuned out as I have tried in vain to do so."

This trouble is often due to the receiving set being placed in close proximity with the house light wiring. If your house happens to be wired with A.C. it is more noticeable. The placing of a stand lamp or desk lamp on the same table as the set is placed on will also produce this hum. To eliminate it, you must either change the position of the set or the wiring itself keeping every part of the set, even the antenna and ground wires, as far away as possible from the light wires.

Two-Tube Selective Reflex Set

Mr. Anthony Gaffney of Rockville Center, L. I., wishes a hook-up for a selective reflex set using two tubes. "One tube to be used for straight audio frequency amplification." The circuit for this is shown below.

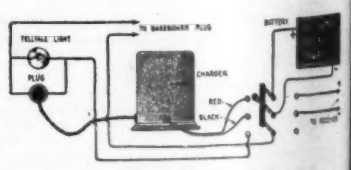


Needs a Grid Condenser

L. J. Meyers of Haverford, Ill., encloses the circuit diagram for his receiver together with a list of the parts which he uses. The set is home made and so far has refused to give forth any sound except a piercing howl despite the adjustment of the dials. Mr. Meyers, if you have given us the exact list of apparatus, you have neglected to include a very necessary grid condenser, .00025 mfd. capacity which should be connected across the grid leak terminals.

Switching Arrangement for Charging

"It is necessary for me to be away from home perhaps for a month or more at a time and my storage battery in that time frequently goes dead. I should like to have an arrangement whereby throwing a switch the other members of the family could put the battery on charge or use it on the set, without connecting and disconnecting a lot of wires, etc.," writes S. G. Fisk of White Plains, N Y.



This arrangement was shown in D. G. Ward's article on storage batteries in the April issue. However we are reprinting it here as its simplicity and handiness will appeal to many readers in a similar circumstance.

(*Continued on page 74*)

BROADCASTING STATION DIRECTORY

The Most Authentic, Up-to-the-Minute List of Stations Broadcasting in the United States, Canada, England, France and Cuba

United States Stations

KDKA	Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, O.	270
KDPT	Southern Electric Co.,.....San Diego, Calif.	244
KDYL	Newhouse Hotel.....Salt Lake City, Utah.	360
KDYM	Savoy Theater.....San Diego, Calif.	280
KDYQ	Oregon Institute of Technology, Portland, Ore.	360
KDYW	Smith Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin.....Honolulu, Hawaii	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Co. .....Seattle, Wash.	270
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZR	Nichols Academy of Dancing.....Denver, Colo.	360
KDZR	Bellingham Publishing Co., Bellingham, Wash.	261
KFAD	MacArthur Bros. Mercantile Co...Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	330
KFAF	Western Radio Corp. .....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAM	The Electric Shop.....Moscow, Idaho	360
KFAR	Studio Lighting Service Co...Hollywood, Calif.	280
KFAU	Boise High School.....Boise, Idaho.	270
KFAW	The Radio Den.....Santa Ana, Calif.	280
KFAY	Virgin's Radio Service.....Medford, Ore.	283
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Anvill.....San Diego, Calif.	278
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church.....Tacoma, Wash.	360
KFBK	Kimball-Upson Co.....Sacramento, Calif.	283
KFBL	Loose Bros.....Everett, Wash.	224
KFBB	Trinidad Gas & Electric Supply Co. and The Chronicle News, Trinidad, Colo.	360
KFBU	The Cathedral.....Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.....Phoenix, Ariz.	238
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)..Billings, Mont.	360
KFCH	Richmond Radio Shop.....Richmond, Calif.	360
KFCP	Ralph W. Flygare.....Ogden, Utah.	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....Le Mars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDD	St. Michael's Cathedral.....Boise, Idaho	252
KFDH	University of Arizona.....Tucson, Ariz.	360
KFDJ	Oregon Agricultural College.....Corvallis, Ore.	360
KFDO	H. Everett Cutting.....Boseman, Mont.	248
KFDR	Bullock's Hdw. & Sporting Goods, York, Nebr.	360
KFDV	Gilbrecht & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College..Brookings, S. Dak.	360
KFDZ	Harry Q. Iverson.....Minneapolis, Minn.	231
KFEC	Meier & Frank Co.....Portland, Ore.	248
KFEJ	Guy Greason .....Tacoma, Wash.	360
KFEL	Wisner Radio Corporation.....Denver, Colo.	360
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Fort Dodge, Iowa	231
KFEV	Feltz Thompson Radio Shop.....Casper, Wyo.	263
KFEK	Augsburg Seminary.....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engs., St. Louis, Mo.	360
KFFB	Jenkins Furniture Co. .....Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFG	E. H. Smith.....Hillsboro, Ore.	229
KFFQ	Marksheffel Motor Co....Colorado Springs, Colo.	360
KFFR	Nevada State Journal.....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphy.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co., Chickasha, Okla.	248
KFGH	Leland Stanford University, Stanford Univ., Calif.	360
KFGL	Snell & Irby.....Arlington, Ore.	234
KFGQ	Crary Hardware Co.....Boone, Iowa	226
KFGB	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary College, Berrien Springs, Mich.	268
KFHA	Western State College of Colo., Gunnison, Colo.	252
KFHB	Rialto Theatre.....Hood River, Ore.	360
KFHD	Uts Radio & Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport, La.	286
KFHJ	Ambrose A. McCue.....Neah Bay, Wash.	261
KFHQ	Fallon & Co. .....Santa Barbara, Calif.	360
KFHS	Star Electric & Radio Co.....Seattle, Wash.	283
KFHX	Clifford J. Dow.....Lihue, Hawaii	275
KFI	Robert W. Nelson.....Hutchinson, Kans.	229
KFID	Earle C. Anthony (Inc.)....Los Angeles, Calif.	468
KFIF	Ross Arbuckle's Garage.....Iola, Kans.	248
KFIL	Benson Polytechnic Institute.....Portland, Ore.	360
KFIO	Windisch Elec. Farm Equip Co., Louisburg, Kans.	234
KFIQ	North Central High School....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	242
KFIU	Alaska Elec. Light & Power Co., Juneau, Alaska	226
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints, Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman, Fon-du-lac, Wis.	273
KFJB	Marshall Electric Co.....Marshalltown, Iowa	248
KFJC	Seattle Post-Intelligencer .....Seattle, Wash	270
KFJF	National Radio Mfg. Co..Oklahoma City, Okla.	252
KFJI	Liberty Theatre .....Astoria, Ore.	252
KFJK	Delano Radio & Electric Co....Bristow, Okla.	233
KFJL	Hardsaeg Manufacturing Co.....Ottumwa, Iowa.	242
KFJM	University of North Dakota, Grand Forks, N. D.	280
KFJQ	Electric Construction Co., Grand Forks, N. Dak.	280
KFJR	Ashley C. Dixon & Son....Stevensville, Mont.	258
KFJV	Thomas H. Warren.....Dexter, Iowa	224
KFJW	Le Grand Radio Co.....Towanda, Kans.	225
KFJX	Iowa State Teachers College..Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas Nat'l Guard, 112 Cav., Fort Worth, Tex.	254
KFKA	Colorado State Teachers College..Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Assn., Milford, Kans.	286
KFKQ	Conway Radio Laboratories.....Conway, Ark.	224
KFKV	F. F. Gray .....Butte, Mont.	283
KFKX	Westinghouse Elec. & Mfg. Co., Hastings, Nebr.	341
KFKZ	Nassour Bros. Radio Co., Colorado Springs, Colo.	234
KFLA	Abner R. Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Menominee, Mich.	248
KFLD	Paul E. Greenlaw.....Franklinton, La.	234
KFLE	National Education Service.....Denver, Colo.	268
KFLH	Erickson Radio Co.....Salt Lake City, Utah	261
KFLP	Everette M. Foster.....Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop.....Little Rock, Ark.	261
KFLR	University of New Mexico..Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House, San Benito, Tex.	236
KFLV	A. T. Frykman.....Rockford, Ill.	229
KFLW	Missoula Electric Supply Co...Missoula, Mont.	234
KFLX	George R. Clough.....Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.....Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.....Atlantic, Iowa	273
KFMB	Christian Churches of Little Rock, Little Rock, Ark.	254
KFMQ	University of Arkansas.....Fayetteville, Ark.	263
KFMR	Morningside College .....Sioux City, Iowa.	261
KFMS	Freimuth Department Store....Duluth, Minn.	275
KFMT	George W. Young.....Minneapolis, Minn.	231

APPLAUSE WIRELESS AGE.
YOUR ADOPTION OF THE BRITISH, FRENCH AND CUBAN STATIONS, IN THE MAY ISSUE — IS JUST ANOTHER EVIDENCE OF YOUR KEEPING US WELL INFORMED
H.R. TOMLINSON
LAKE PLACID, N.Y.

KFMU	Stevens Bros. .....San Marcos, Tex.	240
KFMW	M. G. Satern.....Houghton, Mich.	286
KFMX	Carleton College.....Northfield, Minn.	233
KFMY	Boy Scouts of America.....Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club...Roswell, N. Mex.	250
KFNC	Alonzo Monk, Jr. .....Corsicana, Tex.	234
KFNF	Henry Field Seed Co.....Shenandoah Iowa	266
KFNG	Wooten's Radio Shop.....Coldwater, Miss.	254
KFNH	State Teachers College.....Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop...Warrensburg, Mo.	234
KFNL	Radio Broadcast Association..Paso Robles, Calif.	240
KFNV	L. A. Drake.....Santa Rosa, Calif.	234
KFNX	Peabody Radio Service.....Peabody, Kans.	240
KFNY	Montana Phonograph Co. .....Helena, Mont.	261
KFNZ	Royal Radio Co. .....Burlingam, Calif.	231
KFOA	Rhodes Co. .....Seattle, Wash.	455
KFOB	Glenwood Technical Assn., Minneapolis, Minn.	224
KFOC	First Christian Church.....Whittier, Calif.	236
KFOD	The Radio Shop.....Wallace, Idaho	224
KFOF	Rohrer Electric Co.....Marshfield, Ore.	240
KFOH	Radio Bungalow .....Portland, Ore.	283
KFOJ	Moberly High School Radio Club, Moberly, Mo.	248
KFOL	Leslie M. Schafbuch .....Marengo, Iowa	234
KFON	Echophone Radio Shop....Long Beach, Calif.	234
KFOP	Willson Construction Co.....Dallas, Tex.	268
KFPB	Edwin J. Brown.....Seattle, Wash.	224
KFSG	Echo Park Evangelistic Assn., Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock Watson Radio Service..Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGO	General Electric Co.....Oakland, Calif.	312
KGU	Marion A. Mulrony.....Honolulu, Hawaii	360
KGW	Portland Morning Oregonian....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	238
KHJ	Times-Mirror Co.....Los Angeles, Calif.	395
KHQ	Louis Wasmer .....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	273
KJR	Northwest Radio Service Co.....Seattle, Wash.	283
KJS	Bible Inst. of Los Angeles, Los Angeles, Calif.	360
KLS	Warner Bros. Radio Supplies Co., Oakland, Calif.	360
KLX	Tribune Publishing Co.....Oakland, Calif.	509
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMJ	San Joaquin Light & Power Corp., Fresno, Cal.	248
KMO	Love Electric Co.....Tacoma, Wash.	360
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	283
KNV	Radio Supply Co. .....Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts, State College, N. Mex.	360
KOP	Detroit Police Department.....Detroit, Mich.	286
KPO	Hale Bros. .....San Francisco, Calif.	423
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co., Pittsburgh, Pa.	273
KQW	Charles D. Herrold.....San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	275
KSD	Post-Dispatch.....St. Louis, Mo.	545
KSS	Prest & Dean Radio Co., and Radio Research Society of Long Beach, Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	Examiner Printing Co.....San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KYQ	The Electric Shop.....Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co...Chicago, Ill.	536
KZM	Preston D. Allen.....Oakland, Calif.	360
KZN	Cape & Johnson.....Salt Lake City, Utah	268
KZV	Wenatchee Bat. & Motor Co., Wenatchee, Wash.	360
WAAB	Valdemar Jensen.....New Orleans, La.	268
WAAC	Tulane University.....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal....Chicago, Ill.	360
WAAM	I. R. Nelson Co.....Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	254
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WABA	Lake Forest College.....Lake Forest, Ill.	268
WABB	John B. Lawrence.....Harrisburg, Pa.	268
WABD	Parker High School.....Dayton, Ohio	283
WABE	Y. M. C. A.....Washington, D. C.	283
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	275
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.....Bangor, Me.	248
WABL	Connecticut Agricultural College...Storrs, Conn.	263
WABM	F. A. Doherty Automotive & Radio Equipment Co., Saginaw, Mich.	254
WABN	Ott Radio (Inc.).....La Crosse, Wis.	244
WABO	Lake Avenue Baptist Church..Rochester, N. Y.	252
WABP	Robert F. Weinig.....Dover, Ohio	266
WABQ	Haverford College Radio Club..Haverford, Pa.	261
WABR	Scott High School.....Toledo, Ohio	270
WABS	Essex Mfg. Co.....Newark, N. J.	244
WABT	Holliday-Hall .....Washington, Pa.	252
WABU	Victor Talking Machine Co.....Camden, N. J.	226
WABV	John H. De Witt.....Nashville, Tenn.	263
WABW	College of Wooster.....Wooster, Ohio	254
WABX	Henry B. Joy.....Mount Clemens, Mich.	270
WABY	John Magaldi, Jr.....Philadelphia, Pa.	242
WAAZ	Coliseum Place Baptist Church..New Orleans, La.	263
WBAA	Purdue University.....West Lafayette, Ind.	360
WBAD	Sterling Electric Co.....Minneapolis, Minn.	360
WBAH	The Dayton Co.....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation.....Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co. (Star Telegram), Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.....Columbus, Ohio	360
WBAX	John H. Stenger, Jr.....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.....New York, N. Y.	492
WBBA	Newark Radio Laboratories.....Newark, Ohio	248
WBBD	Barbey Battery Service.....Reading, Pa.	234
WBBE	Alfred R. Marcy.....Syracuse, N. Y.	248
WBBF	Georgia School of Technology.....Atlanta, Ga.	270
WBBG	Irving Vermilya.....Mattapoisett, Mass.	240
WBBH	J. Irving Bell.....Port Huron, Mich.	240
WBBI	Indianapolis Radio Club.....Indianapolis, Ind.	234
WBBJ	Neel Electric Co.....West Palm Beach, Fla.	258
WBBL	Grace Covenant Church.....Richmond, Va.	283
WBBM	Frank Atlass Produce Co.....Lincoln, Ill.	226
WBBN	A. B. Blake.....Wilmington, N. C.	275
WBBO	Michigan Limestone & Chem. Co..Rogers, Mich.	250
WBBP	Petoskey High School.....Petoskey, Mich.	248
WBBQ	Frank Crook.....Pawtucket, R. I.	252
WBBR	Peoples Pulpit Associations....Rossville, N. Y.	244
WBBS	First Baptist Church.....New Orleans, La.	250
WBBT	Lloyd Bros. .....Philadelphia, Pa.	254
WBBU	Jenks Motor Sales Co.....Monmouth, Ill.	234
WBBV	Johnstown Radio Co.....Johnstown, Pa.	248
WBBW	Ruffner Junior High School.....Norfolk, Va.	222
WBBY	Washington Light Infantry....Charleston, S. C.	266
WBBZ	Noble S. Watson.....Indianapolis, Ind.	227

WBL	T. & H. Radio Co.	Anthony, Kans. 261
WBS	D. W. May (Inc.)	Newark, N. J. 360
WBT	Southern Radio Corporation	Charlotte, N. C. 360
WBZ	Westinghouse Elec. & Mfg. Co.,	Springfield, Mass. 337
WCAD	St. Lawrence University	Canton, N. Y. 280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa. 462
WCAG	Clyde R. Randall	New Orleans, La. 268
WCAH	Enirekin Electric Co.	Columbus, Ohio 286
WCAJ	Nebraska Wesleyan University,	University Place, Nebr. 360
WCAK	Alfred P. Daniel	Houston, Tex. 263
WCAL	St. Olaf College	Northfield, Minn. 360
WCAM	Villanova College	Villanova, Pa. 360
WCAO	Sanders & Stayman Co.	Baltimore, Md. 360
WCAP	Chesapeake & Potomac Tel. Co.,	Washington, D. C. 469
WCAR	Southern Radio Corp. of Texas,	San Antonio, Tex. 360
WCAS	William Hood Dunwoody Industrial Institute,	Minneapolis, Minn. 280
WCAT	South Dakota State School of Mines,	Rapid City, S. Dak. 240
WCAU	Durham & Co.	Philadelphia, Pa. 286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark. 360
WCAX	University of Vermont	Burlington, Vt. 360
WCAY	Kesselman O'Driscoll Co.	Milwaukee, Wis. 261
WCAZ	Carthage College	Carthage, Ill. 246
WCBA	Charles W. Heimbach	Allentown, Pa. 280
WCBC	University of Michigan	Ann Arbor, Mich. 280
WCBD	Wilbur G. Voliva	Zion, Ill. 345
WCBE	Uhalt Radio Co.	New Orleans, La. 263
WCBG	Howard S. Williams	Pascagoula, Miss. 236
WCBH	University of Mississippi	Oxford, Miss. 242
WCK	Stix-Baer & Fuller Dry Goods Co.,	St. Louis, Mo. 360
WCM	University of Texas	Austin, Tex. 360
WCX	Detroit Free Press	Detroit, Mich. 517
WDAE	Tampa Daily Times	Tampa, Fla. 360
WDAF	Kansas City Star	Kansas City, Mo. 411
WDAG	J. Laurance Martin	Amarillo, Tex. 263
WDAH	Trinity Methodist Church (South),	El Paso, Tex. 268
WDAK	The Courant	Hartford, Conn. 281
WDAO	Automotive Electric Co.	Dallas, Tex. 360
WDAP	Board of Trade	Chicago, Ill. 360
WDAR	Lit Brothers	Philadelphia, Pa. 395
WDAS	Samuel A. Waite	Worcester, Mass. 360
WDAU	Slocum & Kilburn	New Bedford, Mass. 360
WDAY	Radio Equipment Corporation,	Fargo, N. Dak. 244
WDBC	Kirk, Johnson & Co.	Lancaster, Pa. 360
WDM	Church of the Covenant	Washington, D. C. 234
WDZ	James L. Bush	Tuscola, Ill. 278
WEAA	Frank D. Fallain	Flint, Mich. 250
WEAF	American Tel. & Tel. Co.	New York, N. Y. 492
WEAH	Wichita Board of Trade	Wichita, Kans. 288
WEAI	Cornell University	Ithaca, N. Y. 286
WEAJ	University of South Dakota,	Vermillion, S. Dak. 283
WEAM	Borough of North Plainfield,	North Plainfield, N. J. 252
WEAN	Shepard Co.	Providence, R. I. 273
WEAO	Ohio State University	Columbus, Ohio 360
WEAP	Mobile Radio Co.	Mobile, Ala. 360
WEAR	Baltimore American and News Publishing Co.,	Baltimore, Md. 360
WEAU	Davidson Bros. Co.	Sioux City, Iowa 360
WEAY	Iris Theater	Houston, Tex. 360
WEB	Benwood Co.	St. Louis, Mo. 273
WEV	Hurlburt-Still Electrical Co.	Houston, Tex. 360
WEW	St. Louis University	St. Louis, Mo. 261
WFAA	Dallas News and Dallas Journal	Dallas, Tex. 476
WFAB	Carl Woose	Syracuse, N. Y. 234
WFAM	Times Publishing Co.	St. Cloud, Minn. 273
WFAV	H. C. Spratley Radio Co.	Poughkeepsie, N. Y. 360
WFAH	Electric Supply Co.	Port Arthur, Tex. 236
WFAJ	Hi-Grade Wireless Instrum't Co.,	Asheville, N. C. 360
WFAN	Hutchinson Elec. Service Co.,	Hutchinson, Minn. 360
WFAQ	Missouri Wesleyan College	Cameron, Mo. 360
WFAT	New Columbus College	Sioux Falls, S. Dak. 258
WFAV	University of Nebraska	Lincoln, Nebr. 275
WFI	Strawbridge & Clothier	Philadelphia, Pa. 395
WGAL	Lancaster Elec. Sup. & Const. Co.,	Lancaster, Pa. 246
WGAN	Cecil E. Lloyd	Pensacola, Fla. 360
WGAQ	Glenwood Radio Corporation	Shreveport, La. 252
WGAW	Ernest C. Albright	Altoona, Pa. 261
WGAZ	South Bend Tribune	South Bend, Ind. 360
WGI	American Radio and Research Corporation,	Medford Hillside, Mass. 360
WGL	Thomas F. J. Howlett	Philadelphia, Pa. 360
WGR	Federal Tel. & Tel. Co.	Buffalo, N. Y. 319
WGV	Interstate Electric Co.	New Orleans, La. 242
WGY	General Electric Co.	Schenectady, N. Y. 380
WHA	University of Wisconsin	Madison, Wis. 360
WHAA	State University of Iowa	Iowa City, Iowa 484
WHAB	Clark W. Thompson	Galveston, Tex. 360
WHAD	Marquette University	Milwaukee, Wis. 280
WHAG	University of Cincinnati	Cincinnati, Ohio 222
WHAH	Hafer Supply Co.	Joplin, Mo. 283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va. 258
WHAM	University of Rochester (Eastman School of Music),	Rochester, N. Y. 283
WHAP	Otta and Kuhns	Decatur, Ill. 360
WHAR	Seaside House	Atlantic City, N. J. 231
WHAS	Courier-Journal and Louisville Times,	Louisville, Ky. 400
WHAV	Wilmington Elect. Spec. Co.,	Wilmington, Del. 360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y. 360
WHB	Sweeney School Co.	Kansas City, Mo. 411
WHK	Radiovox Co.	Cleveland, Ohio 283
WHN	George Schubel	New York, N. Y. 360
WIAB	Joslyn Automobile Co.	Rockford, Ill. 252
WIAC	Galveston Tribune	Galveston, Tex. 360
WIAD	Howard R. Miller	Philadelphia, Pa. 254
WIAF	Gustav A. DeCortin	New Orleans, La. 234
WIAI	Heer Stores Co.	Springfield, Mo. 252
WIAJ	Fox River Valley Radio Sup. Co.,	Neenah, Wis. 224
WIAK	Journal-Stockman Co.	Omaha, Nebr. 278
WIAO	School of Engr'g of Milwaukee,	Milwaukee, Wis. 360
WIAQ	Chronicle Publishing Co.	Marion, Ind. 226
WIAS	Home Electric Co.	Burlington, Iowa 360
WIAU	American Trust Savings Bank,	Le Mars, Iowa 360
WIK	K. & L. Electric Co.	McKeesport, Pa. 234
WIL	Continental Elec'l Supply Co.,	Washington, D. C. 360
WIP	Gimbel Bros.	Philadelphia, Pa. 509
WJAD	Jackson's Radio Eng'g Laboratories,	Waco, Tex. 360
WJAF	Muncie Press and Smith Elec. Co.,	Muncie, Ind. 360
WJAG	Norfolk Dairy News	Norfolk, Nebr. 283
WJAK	Clifford L. White	Greentown, Ind. 254
WJAM	D. M. Perham	Cedar Rapids, Iowa 268
WJAN	Peoria Star	Peoria, Ill. 280
WJAQ	Capper Publications	Topeka, Kans. 360
WJAR	The Outlet Co.	Providence, R. I. 360
WJAS	Pittsburgh Radio Supply House,	Pittsburgh, Pa. 250
WJAT	Kelley-Vawter Jewelry Co.	Marshall, Mo. 360
WJAX	Union Trust Co.	Cleveland, Ohio 390
WJAZ	Chicago Radio Laboratory	Chicago, Ill. 448
WJD	Denison University	Granville, Ohio 229
WJX	Deforest Radio Tel. & Tel. Co.,	New York, N. Y. 360
WJY	Radio Corporation of America,	New York, N. Y. 405
WJZ	Radio Corporation of America,	New York, N. Y. 455
WKAA	H. F. Paar	Cedar Rapids, Iowa 268
WKAD	Charles Looff (Crescent Park),	E. Providence, R. I. 240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Tex. 360
WKAN	United Battery Service Co.	Montgomery, Ala. 226
WKAP	Dutee W. Flint	Cranston, R. I. 360
WKAQ	Radio Corporation of Porto Rico,	San Juan, P. R. 360
WKAR	Michigan Agri. College,	East Lansing, Mich. 280
WKAV	Laconia Radio Club	Laconia, N. H. 254
WKY	WKY Radio Shop	Oklahoma, Okla. 360
WLAG	Cutting & Washington Radio Corporation,	Minneapolis, Minn. 417
WLAH	Samuel Woodworth	Syracuse, N. Y. 234
WLAJ	Waco Electrical Supply Co.	Waco, Tex. 360
WLAK	Vermont Farm Machine Corp.,	Bellows Falls, Vt. 360
WLAL	Naylor Electrical Co.	Tulsa, Okla. 360
WLAP	W. V. Jordon	Louisville, Ky. 360
WLAQ	Arthur E. Schilling	Kalamazoo, Mich. 283
WLAV	Electric Shop	Pensacola, Fla. 254
WLAW	Police Dept., City of N. Y.,	New York N. Y. 360
WLAX	Putnam Electric Co.	Greencastle, Ind. 231
WLB	University of Minnesota	Minneapolis, Minn. 360
WLW	Crosley Mfg. Co.	Cincinnati, Ohio 309
WMAB	Radio Supply Co.	Oklahoma, Okla. 360
WMAC	Clive B. Meredith	Cazenovia, N. Y. 281
WMAF	Round Hills Radio Corp.	Dartmouth, Mass. 360
WMAH	General Supply Co.	Lincoln, Nebr. 254
WMAJ	Drovers Telegram Co.	Kansas City, Mo. 275
WMAK	Norton Laboratories	Lockport, N. Y. 360
WMAL	Trenton Hardware Co.	Trenton, N. J. 256
WMAN	First Baptist Church	Columbus, Ohio 286
WMAP	Utility Battery Service	Easton, Pa. 246
WMAQ	Chicago Daily News	Chicago, Ill. 447
WMAV	Alabama Polytechnic Institute	Auburn, Ala. 250
WMAW	Wahpeton Electric Co.	Wahpeton, N. Dak. 254
WMAY	Kingshighway Presby. Church,	St. Louis, Mo. 268
WMAZ	Mercer University	Macon, Ga. 268
WMC	Commercial Appeal	Memphis, Tenn. 500
WMU	Doubleday-Hill Electric Co.	Washington, D. C. 261
WNAC	Shepard Stores	Boston, Mass. 360
WNAD	University of Oklahoma	Norman, Okla. 360
WNAL	R. J. Rockwell	Omaha, Nebr. 266
WNAN	Syracuse Radio Telephone Co.,	Syracuse, N. Y. 268
WNAP	Wittenberg College	Springfield, Ohio 275
WNAQ	Charleston Radio Elec. Co.	Charleston, S. C. 360
WNAR	C. C. Rhodes	Butler, Mo. 231
WNAS	Texas Radio Corp. and Austin Steam Laundry,	Austin, Tex. 360
WNAT	Lenning Brothers Co.	Philadelphia, Pa. 360
WNAV	Peoples Tel. & Telg. Co.	Knoxville, Tenn. 236
WNAW	Henry Kunzman	Box 167, Fort Monroe, Va. 360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak. 244
WNJ	Shotton Radio Mfg. Co.	Albany, N. Y. 360
WOAC	Page Organ Co. (H. P. Maas)	Lima, Ohio 360
WOAD	Friady Battery & Electric Corp.,	Sigourney, Iowa. 360
WOAE	Midland College	Fremont, Neb. 360
WOAF	Tyler Commercial College	Tyler, Tex. 360
WOAG	Appollo Theatre	Belvidere, Ill. 273
WOAH	Palmetto Radio Corporation	Charleston, S. C. 360
WOAI	Southern Equipment Co.	San Antonio, Tex. 395
WOAN	James D. Vaughn	Lawrenceburg, Tenn. 360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind. 360
WOAP	Kalmazoo College	Kalamazoo, Mich. 283
WOAR	Henry P. Lundskow	Kenosha, Wis. 229
WOAT	Boyd M. Hamp	Wilmington, Del. 360
WOAV	Pennsylvania Nat. Guard, 112th Inf.	Erie, Pa. 242
WOAW	Woodmen of the World	Omaha, Neb. 526
WOAX	Franklyn J. Wolff	Trenton, N. J. 240
WOC	Palmer School of Chiropractic	Davenport, Iowa 484
WOI	Iowa State College	Ames, Iowa 360
WOK	Pine Bluff Co.	Pine Bluff, Ark. 360
WOO	John Wanamaker	Philadelphia, Pa. 509
WOQ	Western Radio Co.	Kansas City, Mo. 360
WOR	L. Bamberger & Co.	Newark, N. J. 405
WOS	Missouri State Market'g Bu.,	Jefferson City, Mo. 441
WPAB	Pennsylvania State College	State College, Pa. 283
WPAC	Donaldson Radio Co.	Okmulgee, Okla. 330
WPAJ	Doolittle Radio Corp.	New Haven, Conn. 268
WPAK	North Dakota Agricultural College,	Agricultural College, N. Dakota 360
WPAL	Avery & Loeb Electric Co.	Columbus, Ohio 286
WPAM	Auerbach & Guettel	Topeka, Kans. 360
WPAP	Theodore D. Phillips	Winchester, Ky. 360
WPAQ	General Sales & Engineering Co.,	Frostburg, Md. 360
WPAT	St. Patrick's Cathedral	El Paso, Tex. 360
WPAU	Concordia College	Moorhead, Minn. 280
WPAZ	John R. Koch	Charleston, W. Va. 273
WQAA	Horace A. Beale, Jr.	Parkesburg, Pa. 360
WQAC	E. B. Gish	Amarillo, Texas 234
WQAD	Whitall Electric Co.	Waterbury, Conn. 242
WQAE	Moore Radio News Station	Springfield, Vt. 275
WQAF	Sandusky Register	Sandusky, Ohio 240
WQAL	Coles County Tele. & Teleg. Co.	Mattoon, Ill. 258
WQAM	Electrical Equipment Co.	Miami, Fla. 268
WQAN	Scranton Times &	Scranton, Pa. 230
WQAO	Calvary Baptist Church	New York, N. Y. 360
WQAQ	W. Texas Radio Co. (Abilene Dairy Reporter)	Abilene, Texas 360
WQAS	Prince-Walter Co.	Lowell, Mass. 268
WQAW	Catholic University	Washington, D. C. 236
WQAX	Radio Equipment Co.	Peoria, Ill. 360
WRAA	Rice Institute	Houston, Texas 360
WRAF	The Radio Club	Laporte, Ind. 224
WRAH	Stanley N. Read	Providence, R. I. 231
WRAL	Northern States Power Co.,	St. Croix Falls, Wis. 248
WRAM	Lombard College	Galesburg, Ill. 244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa 236
WRAO	St. Louis Radio Service Co.	St. Louis Mo. 360
WRAV	Antioch College	Yellow Springs, Ohio 242
WRAW	Avenue Radio Shop	Reading, Pa. 238
WRAX	Flexon's Garage	Gloucester City, N. J. 268
WRAY	Radio Sales Corporation	Scranton, Pa. 280
WRAZ	Radio Shop of Newark	Newark, N. J. 233
WRC	Radio Corporation of America,	Washington, D. C. 469
WRK	Dorcu Bros. Electrical Co.	Hamilton, Ohio 360
WRL	Union College	Schenectady, N. Y. 360
WRM	University of Illinois	Urbana, Ill. 360
WRR	City of Dallas, Police and Fire Signal Dept.	Dallas, Texas 360
WRW	Tarrytown Radio Res'rch Lab.,	Tarrytown, N. Y. 273
WSAB	Southeast Missouri State Teachers College,	Cape Girardeau, Mo. 360
WSAC	Clemson Agricultural Col.,	Clemson College, S. C. 360
WSAD	J. A. Foster Co.	Providence, R. I. 261
WSAG	Loren V. Davis and George Prestman, Sr.,	St. Petersburg, Fla. 244
WSAI	United States Playing Card Co.,	Cincinnati, O. 309
WSAJ	Grove City College	Grove City, Pa. 360
WSAN	Allentown Radio Club	Allentown, Pa. 229
WSAR	Doughty & Welch Elec. Co.,	Fall River, Mass. 254
WSAT	Donohoo-Ware Hardware Co.	Plainview, Tex. 268
WSAW	John J. Long, Jr.	Canandaigua, N. Y. 275
WSAX	Chicago Radio Laboratory	Chicago, Ill. 288
WSAY	Port Chester Chamber of Commerce,	Port Chester, N. Y. 233
WSAZ	Chase Electric Shop	Pomeroy, Ohio 258
WSB	Atlanta Journal	Atlanta, Ga. 429
WSL	J. & M. Electrical Co.	Utica, N. Y. 273
WSY	Alabama Power Co.	Birmingham, Ala. 360
WTAB	Fall River Daily Herald Publishing Co.,	Fall River, Mass. 248
WTAC	Penn Traffic Co.	Johnstown, Pa. 360
WTAF	Louis J. Gallo	New Orleans, La. 268
WTAG	Kern Music Co.	Providence, R. I. 258
WTAH	Carmen Ferro	Belvidere, Ill. 236
WTAJ	The Radio Shop	Portland, Me. 236
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio 252
WTAM	Willard Storage Battery Co.	Cleveland, O. 390
WTAP	Cambridge Radio & Electric Co.	Cambridge, Mass. 360
WTAQ	E. H. Van Gorder & Son	Osseo, Wis. 275
WTAR	Reliance Electric Co.	Norfolk, Va. 360
WTAS	Charles E. Erbstein	Elgin, Ill. 273
WTAT	Edison Electric Illuminating Co.	Boston, Mass. 360
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr. 360
WTAW	Agricultural and Mechanical College of Texas,	College Station, Tex. 360
WTAX	Williams Hardware Co.	Streator, Ill. 360
WTAY	Iodar-Oak Leaves Broadcast. Sta.	Oak Park, Ill. 275
WTAZ	Thomas J. McGuire	Lambertville, N. J. 360
WTG	Kansas State Agri. Coll.	Manhattan, Kans. 360
WWAB	Hoenig, Swern & Co.	Trenton, N. J. 360
WWAC	Sanger Bros.	Waco, Tex. 360
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa. 360
WWAE	Lawrence J. Crowley	Joliet, Ill. 360
WWAF	Galvin Radio Supply Co.	Camden, N. J. 360
WWAO	Michigan College of Mines	Houghton, Mich. 360
WWI	Ford Motor Co.	Dearborn, Mich. 360
WWJ	Detroit News	Detroit, Mich. 517
WWL	Loyola University	New Orleans, La. 360

Canadian Stations

CFAC	The Calgary Herald	Calgary, Alta. 435
CFCA	Star Publishing & Printing Co.	Toronto, Ont. 435
CFCF	Marconi Wireless Telegraph Co. of Canada,	Montreal, Que., Canada 435
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont. 435
CFCJ	La Cie. de L'Evenement	Quebec, P. Q. 435
CFCK	Radio Supply Co., Ltd.	Edmonton, Alta. 435
CFCL	Centennial Methodist Church	Victoria, B. C. 435
CFCN	W. W. Grant Radio, Ltd.	Calgary, Alta. 435
CFCO	Semmelhaack-Dickson, Ltd.	Bellevue, Que. 435
CFCQ	Radio Specialties, Ltd.	Vancouver, B. C. 435
CFCR	Laurentide Air Service, Ltd.	Sudbury, Ont. 435
CFCW	The Radio Shop	London, Ont. 435
CFDC	Sparks Co.	Nanaime, B. C. 435
CFQC	The Electric Shop, Ltd.	Saskatoon, Sask. 435
CFRC	Queens University	Kingston, Ont. 435
CFUC	University of Montreal	Montreal, Que. 435
CFXC	Westminster Trust Co.	New Westminster, B. C. 435
CHAC	Radio Engineers	Halifax, N. S. 435
CHBC	The Albertan Publishing Co.	Calgary, Alta. 435
CHCB	Marconi Wireless Telegraph Co. of Canada, Ltd.,	Toronto, Ont. 435
CHCD	Canadian Wireless & Elec. Co.	Quebec, Que. 435
CHCE	Western Canada Radio Supply	Victoria, B. C. 435
CHCL	The Vancouver Merchants Exchange, Ltd.,	Vancouver, B. C. 435
CHCM	Riley & McCormack, Ltd.	Calgary, Alta. 435
CHCS	The Hamilton Spectator	Hamilton, Ont. 435
CHYC	Northern Electric Co., Ltd.	Montreal, Que. 435
CJCA	The Edmonton Journal, Ltd.	Edmonton, Alta. 435
CJCM	J. L. Phillips Landry	Mont Joli, Que. 435
CJGC	London Free Press Printing Co.	London, Ont. 435
CJCD	The T. Eaton Co., Ltd.	Toronto, Ont. 435
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C. 435
CJCI	Maritime Radio Corp., Ltd.	St. John, N. B. 435
CJCN	Simons Agnew & Co.	Toronto, Ont. 435
CJCX	Percival W. Shackleton	Olds, Alta. 435
CJGC	The Evening Telegram	Toronto, Ont. 435
CKAC	La Presse Publishing Co., Ltd.	Montreal, P. Q. 435
CKCD	Vancouver Daily Province	Vancouver, B. C. 435
CKCE	Canadian Indp. Telephone Co.	Toronto, Ont. 435
CKCH	Canadian National Railways	Ottawa, Ont. 435
CKCK	Leader Publishing Co., Ltd.	Regina, Sask. 435
CKCO	Dr. G. M. Geldert (For Ottawa Radio Assn.),	Ottawa, Ont. 435
CKCX	P. Burns & Co., Ltd.	Calgary, Alta. 435
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont. 435
CKY	Manitoba Telephone System	Winnipeg, Man. 435
CFYC	V. W. Odlum	Vancouver, B. C. 435

British Stations

2LO	London	365
5IT	Birmingham	479
5WA	Cardiff	353
6BM	Bournemouth	385
2ZY	Manchester	385
5NO	Newcastle	400
5SC	Glasgow	420
2BD	Aberdeen	495
6SL	Sheffield (relay station)	306

French Stations

YN	Lyon	450
FL	Paris (Eiffel Tower)	2,650
8AJ	Paris	450
ESP	Paris	1,780

Cuban Stations

PWX	Cuban Telephone Co.	Habana 400
2DW	Pedro Zayas	Habana 400
2AB	Alberto S. de Buntamante	Habana 400
2OK	Mario Garcia Vélez	Habana 400
2BV	Frederick W. Horton	Habana 400
2CX	Frederick W. Horton	Habana 400
2EV	Westinghouse Elec. Co.	Habana 400
2TW	Roberto E. Ramirez	Habana 400
2HC	Heraldo de Cuba	Habana 400
2LC	Luis Casas	Habana 400
2KD	E. Sanches de Fuentes	Habana 400
2MN	Fausto Simon	Habana 400
2MG	Manuel G. Salas	Habana 400
2JQ	Raul Péres Falcon	Habana 400
2KP	Alvaro Daza	Habana 400
2HS	Julio Power	Habana 400
2OL	Oscar Collado	Habana 400
2WW	Amadeo Saenz	Habana 400
5KW	Frank H. Jones	Tuinucu 400
6KW	Frank H. Jones	Cienfuegos 400
6KJ	Antonio T. Figueroa	Cienfuegos 400
6CX	Eduardo Terry	Cienfuegos 400
6DW	José Gandaxe	Cienfuegos 400
6BY	Valentin Ulivarri	Cienfuegos 400
6AZ	Josefa Alvarez	Caibarien 400
6EV	Pedro Nogueras	Camagey 400
7AZ	Salvador Rionda	Camagey 400
7BY	Alfredo Broocks	Santiago de Cuba 400
8AZ	Alberto Ravelo	Santiago de Cuba 400
8BY	Andrés Vinnet	Santiago de Cuba 400
8FU	Pedro C. Anduz	Santiago de Cuba 400
8DW	Eduardo Mateos	Santiago de Cuba 400
8EV	Juan F. Chibas	Santiago de Cuba 400
8GT		

High Lights in Radio Development

Testing head set in the C. Brandes' laboratories

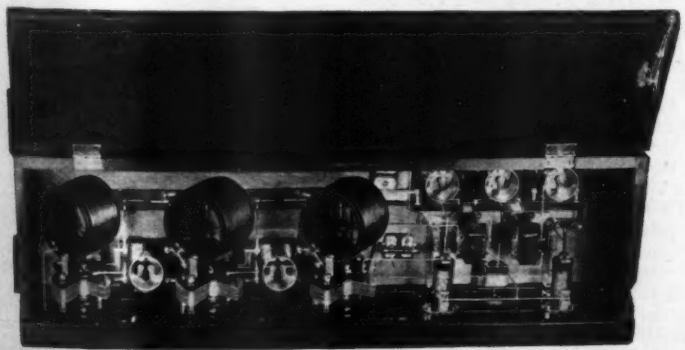
THIS MONTH

Announcing Trains—
A New Storage Battery—
A Ten-Year Lease—
Matching Tone Quality—
On a Canadian Trap Line

THE Interboro Railroad of New York has adopted the Callophone amplifying system for announcing trains at the busy express stations. Its premièrè appearance took place at Times Square station, the busiest station of the entire line, and probably of any railroad system in the world. This is the culmination of many other installations in commercial houses which have given the Callophone a great deal of prestige.

ROBERTS Radio Storage "B" Battery Company and the Todd Electric Company, make an alkaline "B" Battery with a unique arrangement of test tubes for cells, some Edison elements, yards of heavy pure nickel wire and a solution of Potassium Hydroxide (Potash). The battery has a capacity of 1,500 milliamperes and it is estimated can be recharged for only 5 cents. The Roberts "B" battery has 2 switch levers which give instant voltage changes upon a series of taps, giving a voltage range of from 16, 22, 44 and 140. The Todd is also tapped off. The sets are portable and are mounted in well-built mahogany finished cabinets which tend to give them an extremely neat appearance.

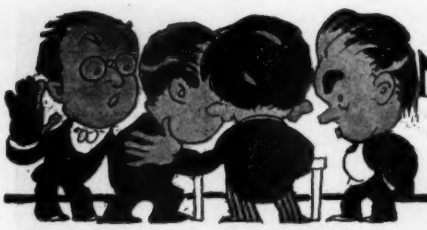
THE world's first annual international exposition will be held at Madison Square Garden, New York City, September next. This radio show will open Monday, September 22nd, and continue until Sunday, September 28th. It will be held under the auspices of the newly organized Radio Manufacturers' Show Association, composed of sixty of the most prominent American radio manufacturers. U. J. Herrmann and James F. Kerr, the well-known theatrical managers, who made such a gigantic success of the annual Chicago radio show, will be Managing Director and General Manager, respectively. There will also be an advisory board made up of E. B. Mallory, Chairman of the Radio Division of the Associated Manufacturers of Electrical Supplies, Paul B. Klugh, Executive Secretary of the National Association of Broadcasters, and Calvin Harris, the pioneer radio publicity expert. The Radio Manufacturers' Show Association will hold three great expositions next season which will probably revolutionize the show end of the business. The first will be held in New York, September 22 to 28, the second will be held in Chicago at the Coliseum, November 18 to 23, and the third will take place on the Pacific Coast early in 1925. The Board of Directors of the R. M. S. A. has taken an exclusive ten-year lease on Madison Square Garden for its annual and international radio show which will be held there every Fall until 1934. The Association has also taken over the Chicago Coliseum for a like period, and another ten-year lease is being negotiated on the Western exposition building. The new organization which is heavily financed is indeed a permanent institution which promises to be of great benefit to radio in general. The outstanding feature next season will be the introduction of foreign exhibits. There will also be a series of ultra-important public experiments and demonstrations for the purpose of bringing to light and testing out new radio inventions and theories. In addition to awarding suitable prizes to all successful inventors of the show management will also endeavor to assist them to market their inventions to the best possible advantage, gratis. Another interesting feature will be the Amateur Builders' Contest which will surpass all former competitions of the kind. The decorative equipment of the coming exposition will be the most elaborate ever built for an American trade show of any sort. Manager Kerr has opened headquarters at the Hotel Prince George, 14 East 28th St., New York City, where he will remain with his personal staff until September 15th.



A five tube Neutrodyne in which Fil-Ko-Stats have replaced the usual wire rheostats for filament control. This set, operating in Harrisburg, Pa., receives California stations nightly, often while the locals are operating and always when they have shut down

THE manufacture of reliable radio head sets is marked by test after test, and the greatest possible accuracy must guide each succeeding operation from the time the receiver cut is fashioned until the completed headset is finally passed for shipment. Minute currents of the order of one-millionth of an ampere will make audible sounds in a really sensitive headset, and the fact that it is possible to hear them seems almost incredible. To produce

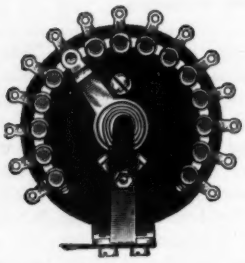
(*Continued on page* 88)



NEW APPLIANCES AND DEVICES

Carter Inductance Switch

THE Carter Inductance Switch made by the Carter Radio Co., does away with the difficult job of mounting and soldering to switch points. It is only necessary to drill one hole in the panel. All contacts are mounted back of the panel, only the knob and dial being exposed on the front of the



panel. It has a contact arm which fits into a depression in the combination contact and solder terminal. A slight "click" sound indicates that a positive connection has been made with but one terminal instead of between two terminal contacts, as is usually the case.

The terminals can be soldered and all connections made before the switch is mounted. This makes a much simpler installation. The contact arm is fitted with a clock spring type of pigtail which eliminates the undesirable sliding contact.

In place of the usual small knob and large dial, the Carter Inductance Switch is furnished with a large tapered knob dial which shows at all times the exact position of the contact arm. There are 15 contacts, but by means of an adjustable stop any number of contacts up to 15 may be used and the balance left idle.

Durham Variable Resistance

LITTLE Omega Durham, the unique trade figure which has helped to introduce the Durham line of variable resistances is familiar to nearly every radio fan.

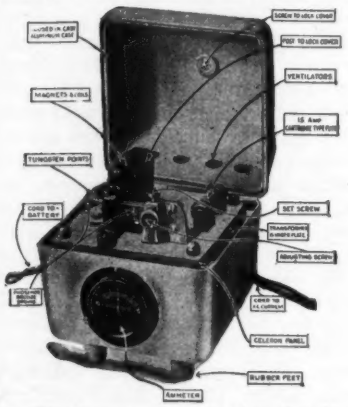
These grid leaks fit the standard grid leak condenser base and can be mounted so that the plunger can be operated from the panel and are adapted to all circuits. It is made in 3 values—1,000 to 100,000 ohms; 0.1 to 5 megohms, and 2,0 to 10 megohms. These products are manufactured by Durham & Co., Philadelphia.

Natann Battery Charger

THE Natann Charger, manufactured by the Natann Mfg. Co., operates on the vibrator principle, and rectifies a suitably stepped-down voltage of alternating current by making and breaking the circuit at the proper intervals, accepting only one side of the alternating current wave. It has an initial charging rate of 8 amperes, from an input current of 110 volts, 60 cycles. This rate tapers as the battery takes the charge.

The case is of polished cast aluminum, mounted on rubber cushion feet.

The interior working parts are mounted on a Celoron panel, and are made of substantial, well-fitted and finished brass castings. The springs are phosphor bronze. Beneath the panel is an oversize transformer, which operates with a minimum temperature



rise. The ammeter body is also placed under the panel, and the dial opens to the front side of the case.

Freshman Double-Adjustable Crystal Detector

CONSIDERABLE interest has been aroused by the New Freshman Double-Adjustable Crystal Detector, which has been found ideal for reflex and crystal circuits.

The Freshman detector unit differs from other units in having a knob which can be brought through to the panel and, when turned, varies the crystal contact with the loop whisker, thus permitting the operator to find sensitive spots quickly without disturbing the tension on the whisker spring.

It has an insulated housing for the crystal, and a lever at the base unit adjusts the contact tension of the whisker which operates in concentric revolutions about the face of the crystal, thus covering every point on the crystal as it is adjusted by a little knob on the panel.

A special crystal of pure natural ore which will withstand voltages as high as 130 without burning out, is used. The crystals themselves are replaceable by fresh units which are sold mounted.

The Bradleyohm

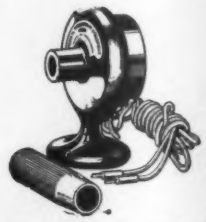
THE Allen-Bradley Co. has added another item to their increasing list of radio products known as the Bradleyohm. The Bradleyohm is an adjustable resistor which is varied over a wide range by applying or removing pressure on the two columns of treated discs by means of an adjusting knob.

The Bradleyohm is admirably suited for such purposes as providing an adjustable resistance across the audio-frequency transformers to reduce distortion; for providing resistors to be used in coupling radio frequency or audio-frequency resistance amplifiers; for adjusting filter couplers of super-heterodyne circuits, and for adjusting push-pull amplifiers.

It is made in three sizes with the following ranges: Bradleyohm 10—10,000 to 100,000 ohms; Bradleyohm 25—25,000 to 250,000 ohms; Bradleyohm 50—50,000 to 500,000 ohms.

"Red Seal" Phonograph Attachment

THE Manhattan Electrical Supply Company is offering for sale a new phonograph attachment under their well-known trade mark "Red Seal." This consists of a special Red Seal receiver attached to a heavy non-resonant metal base with air chamber and diaphragm especially designed



to operate the large air column of a reproducing horn. Attachment is made to the tone arm of the phonograph by means of a soft rubber tube.

The Red Seal Phonograph Attachment is sensitive to faint signals and re-creates musical programs with the same fidelity as the well-known Red Seal Headset.

Medium Frequency Transformer

THE design of a transformer for medium frequency amplification is quite different from the usual amplifying transformer design. Audio frequency transformers must have a considerable volume of iron while the short wavelength radio frequency trans-

formers usually have no iron at all. As the medium frequency transformer falls between both of these limits the natural tendency has been to make it merely a modification of one of these types. It is evident that such a method does not produce a carefully designed instrument.

The type 271 Transformer has been designed by the General Radio Co. as an instrument distinct in itself and particularly adapted to the service required of it. It is shielded both electrostatically and electromagnetically, thus greatly reducing reaction between stages and permitting the associated tubes to be operated at full capacity. Its peak frequency is 30 K.C. (10,000 meters).

Magnavox Electro-dynamic Reproducer

THE new model Magnavox Reproducers R3 and R2 contain refinements making for increased efficiency as well as economy of operation.

Current consumption has been so reduced that the new models can be operated at any point between .1 ampere and .6 ampere when supplied with six volts.

The volume control is a true electrical switch which permits the user to control

current consumption as well as adapt the reproduction to every possible time, place and condition.

Other improvements relate to the diaphragm, the movable coil, and also the external finish and appearance of the instrument.

Radio Cabinet

THE Radio-Spinet, designed by the Bay View Furniture Co., in all essentials is the ideal radio cabinet because of its practical features and its desirability as a beautiful piece of modern furniture.

The Radio-Spinet has ample room in the front compartment to nicely accommodate most of the popular receiving sets, and is by no means limited to any one kind.

All batteries (both wet and dry), charger, and wires are contained in a rear compartment, concealed from view, but instantly accessible through a large size lid which opens up all the way and exposes the entire interior.

Two large roomy drawers, one at each end, provide for the accommodation of all those miscellaneous items which accumulate around the radio—note-books, pencils, programs, clippings, extra tubes, head phones, etc.

The top measures 23 by 45 inches. The receiving set compartment measures 32 inches long, 10¼ inches wide and 7⅛ inches high. The rear battery compartment meas-

ures 32 inches long, 9¾ inches wide, and 11¼ inches deep. The top lid measures 32¼ by 10 inches and opens up, on hinges, all the way.

The back panel has openings for insertion of wires. Other openings can be drilled in as needed.

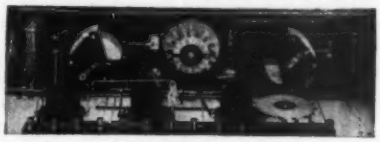
Made of combination mahogany with top and front of solid Honduras mahogany—the best obtainable. Finished in the popular dull-rubbed brown mahogany or in the waxed antique old mahogany with its soft highlights.

Trirdyn Receiver

THE newest addition to the Crosley line, is the Trirdyn 3-R-3 announced on the third anniversary of the corporation. Four important principles are accomplished in receiver design in the Trirdyn: tuned radio frequency amplification with the first tube; Armstrong regenerative detector action with the second tube; reflex amplification by employing the first, or radio frequency tube as an audio amplifier and one-stage of audio frequency with the third tube. These factors combined in the particular arrangement of this receiver, give signal strength of a receiver utilizing five tubes.

The Trirdyn will not re-radiate when receiving broadcasting station signals, due to the fact that the antenna is very loosely coupled to the secondary circuit and a non-oscillating radio-frequency amplifier is employed before the regenerative detector, as a barrier to prevent oscillations generated by the detector upon reaching the antenna.

The primary or antenna circuit of this set is aperiodic or untuned, making it possible to calibrate the secondary circuit and the tuned radio frequency amplifier in terms of wave-length, thereby enabling the receiver to be accurately adjusted to the signals of any broadcasting station from a calibration table or curve sheet.



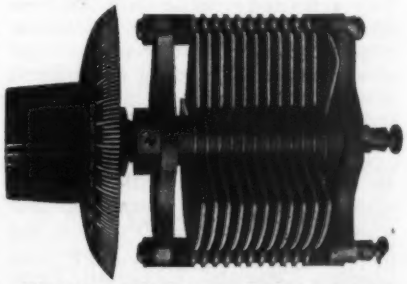
The set is selective because it employs tuned radio frequency, loose-coupled antenna and a tuned secondary. It is possible to receive the distant stations while local stations are transmitting. For example, in Cincinnati it is possible to tune in KDKA which is only seventeen meters higher in wave length than WLW, while the latter station is in operation.

It operates satisfactorily with a small indoor antenna with loud-speaker volume, and good results have been obtained using only a ground connection. It requires a detector and two amplifier tubes of standard type and satisfactory results are obtained when dry cells are employed for lighting the filament, but the volume will be greater with 6-volt tubes.

Cruver Condenser

THE Cruver Manufacturing Company have just put out a new condenser which cuts down the inefficient capacities by means of mounting the stator plates on two rods instead of the three usually used and thereby have reduced the losses to a negligible quantity. A 23-plate condenser showed the same reading at maximum capacity and 290 meters as the standard used, which was stated to have a loss of only seven one-thousandths of one per cent. at a capacity of .001 mfd.

This condenser has two scales on one dial. When the knob is turned either to the right or the left, the vernier plate lines up with the rotor plates and the vernier index reads zero. When the group plates are set for the coarse adjustment the reading shows on the large scale. The knob is then turned in the opposite direction and the fine adjustment is read on the inner scale, thus an accurate log can be obtained, which facilitates tuning in the required station.



Perfect electrical connection between stationary and movable plates is secured without pigtail connections and body capacity is eliminated entirely when the rotor plates are grounded. It can be mounted by means of one nut in a few seconds after the hole for the shaft has been bored.

The D-Coil Receiver

(*Continued from page 36*)

fore if dry cell "B" batteries are used it is advantageous to keep the plate voltage as low as possible to prolong the life of the "B" batteries. The grid return of the two audio-frequency amplifier tubes is connected to the negative filament terminal through a 4.5 "C" battery. This holds the grids 4.5 volts negative and is another aid in prolongation of "B" battery life, although its principal function is to hold the grids at just such a negative value that maximum amplification with minimum distortion will be produced from the audio amplifier. This value of "C" battery voltage is the proper one to use when 90 volts is applied to the plates and if the plate voltage is increased the "C" battery voltage should be increased. The plate circuit of the second audio frequency amplifier tube is connected to the 90-volt tap of the "B" battery through a single or open circuit jack. The only time you will ever use this jack is when you wish to plug in the loud speaker. The volume available here is much too great for the phones. Thus when the loud speaker is removed from the circuit and the phones are plugged in on the detector or the first step, the plate circuit of the second and last tube is open and therefore is not drawing plate current and this also helps to prolong the life of the "B" batteries.

No Stabilizing Resistance Needed

It is to be noted that there is no stabilizing resistance shown in the circuit and none is needed. The circuit is absolutely stable without the application of stabilizing resistances or neutralizing condensers and is therefore simpler in construction, easier to put into operation and much more efficient in operation.

It is necessary to have a good ground. I would not say that a steam pipe ground was sufficient. It is necessary to either have a water pipe ground or an electric light ground. Of course, that theory applies to all receivers, but I have noticed it more with this type of receiver than any other. Without a good ground the receiver will not give the results by a long ways that it is capable of giving.

Will Operate Without Antenna

It will function very nicely without an antenna or loop. With a receiver of this type which I made up and which was located at 207th Street and Broadway, New York City, stations at Chicago, Cleveland, Cincinnati, Pittsburgh, Hastings, Nebraska, and many others were brought in with only a ground connection to the water pipe and using no antenna connection whatever. I have tried this receiver out and am firmly convinced that it is one of the most efficient receivers that can be built, being exceeded only by the super-heterodyne and Regenoflex receivers.

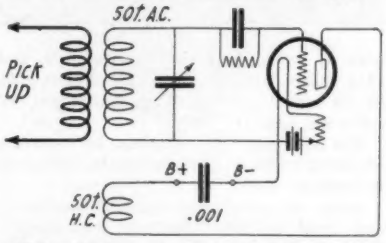
In this circuit the radio-frequency amplification has not been carried to the maximum that is possible, and I think it safe to assume that at least one or two more stages could be put in ahead of the first tube. I haven't tried it out, however. These additional stages of radio-frequency amplification would probably have to be untuned as it would not be advisable to bring any more tuning elements into the circuit. Three is enough. Regarding this circuit that I have described, you will find that if you bring in KFKX at Hastings, Nebraska, with the dials all set at 15 degrees, you will always find him at that point and therefore when you have your dials calibrated in stations it will always be an easy matter to set the dials quickly for any station that you wish to receive.

Information Desk

(*Continued from page 68*)

Oscillator Circuit

E. F. Jones of Detroit, Mich., says, "I would like to have you give me a diagram for a good oscillator circuit that will cover the broadcasting wave band. I have built myself a superheterodyne and have used up to the present time the Hartley oscillator circuit with a UV-201-A tube. I have had a great deal of trouble in trying to make the tube oscillate over the entire wave band, having found it necessary to force the filament and use high plate voltages.



Below is shown an oscillator circuit which will oscillate with the same degree of efficiency over the entire range of the variable condenser. The Hartley circuit is unsuitable for your use and is particularly hard to adjust for maximum oscillation even at one set frequency such as when used in transmitting sets.

How You Can Help Us to Help You Use the Information Desk

Not long ago we received from one of our readers, a letter asking several questions. This letter came so near to being our ideal that we are printing a copy of it here. You will note that the writer made his questions short and to the point; gave what details were necessary to our understanding of his receiver; numbered his questions and left a space below each one where we could very easily jot down the answer and send his original letter back to him with both the questions and answers together. We hope our readers appreciate the time and labor which this method saves in conducting this department. Hereafter all letters to us in this general form or a similar one will receive priority in being answered.

"I am about to build the 5-tube Neutrodyne Receiver shown in Fig. 9, p. 57, Wireless Age for April, 1923. I have searched the lot and no hook-up appeals to me as this one does; but there are a few points I would like to have cleared up. Using the attached envelope would you please set me right in the following:

If you were building this set and had on hand a new Remler variometer and two General Radio A. F. transformers would you

1. *Use the variometer* ☐
2. *Leave it out* ☐
3. *Use the General Radio transformers* ☐
4. *Use* 1 *rheostat for the two A. F. tubes* ☐
5. *Use* 1 *rheostat for the two R. F. tubes* ☐
6. *Use* 1 *rheostat for each tube* ☐
7. *Would a battery of dry cells connected to furnish 6 volts operate, while they last, five 201A tubes as well as a storage battery?* ☐
8. *Nearly as well* ☐
9. *Not nearly so well* ☐

DX Reception

J. A. White of New York City, encloses a diagram of his receiver and asks us how he can get distance. Getting distant stations depends on many things; your location, your antenna, your ground, the condition of your batteries, your familiarity with set and probably last of all, the set itself. Of these mentioned items, familiarity with your particular receiver is most important. This experience cannot be gained by a week's listening-in, but takes months. We know of one type of set in particular that we have operated on which we were able to get very good results, yet in the hands of anyone else the set might as well have been "dead." Learning the proper adjustments of the dials, being able to "feel" for stations, and sensing a resonant circuit, that is tuning.

"The Air Is Full of Things You Shouldn't Miss"

REQUESTS coming in from radio dealers for permission to make use of the slogan, "The Air is Full of Things You Shoudn't Miss," has led the National Carbon Company, creator of the slogan, to define the position taken with all such inquiries.

The company says: "The National Carbon Company has spent a large sum of money in popularizing the slogan, 'The Air is Full of Things You Shouldn't Miss' as applying everywhere and at all times to Eveready Radio Batteries. As a result, the slogan became distinctly associated in the minds of everybody interested in radio with the line of Eveready Radio Batteries manufactured by the National Carbon Company.

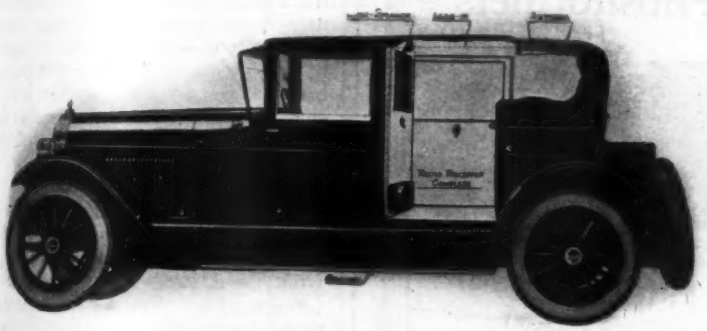
"We have felt it necessary to refuse and we will continue to decline permission to dealers to use it except in advertising Eveready Radio Batteries. For such purposes they are welcome to it in the public prints, in windows and in counter display. But it must at all times be associated with Eveready Radio Batteries only."

Radio for Boatman, Motorist or Hiker

(*Continued from page 26*)

would pass through many towns and cities where small broadcasting stations are situated. We venture to predict that on a trip of this kind, you would probably hear a score of stations which you never had the opportunity to hear before, simply because they were too weak for you to bring in at home. Such a trip would not only give pleasure from its scenic side, but also from the viewpoint of radio.

Of course in neither the motor boat nor the automobile is it possible to receive while the engine is running. Every time your spark plug fires, you have a miniature transmitting set in action, and in a six or eight cylinder car, these explosions occur so often that it would be almost impossible to receive anything else. On some of the larger boats this might be avoided by removing the set as far away as possible, but in most cases trouble may ensue.



A radio-equipped automobile

One enthusiastic radio fan used a device on his boat to overcome this trouble. He got a fifty-foot length of rubber covered copper wire and sealed up the end with a test tube filled with paraffin. When the boat was in motion, this wire was thrown over the stern and broadcasting was actually received, despite the fact that the aerial was under water. The rubber covering was, of course, waterproof, while the test tube prevented leakage at the end of the wire.

Such a device as this might work out quite well in some cases, but it is a subject which is not to be counted upon too much.

In the automobile this trailing wire cannot be used, of course, and in most cases it will be found that the only time radio listening can be indulged in will be when the engine is not running. There may be some cases where reception has been accomplished in close proximity to a running gasoline engine, but the writer has never yet seen a really successful demonstration.

Automobile reception will limit itself to evenings spent in hotels and possible noonday stops for lunches. The rest of the time the set will be of little use, but it will certainly be enjoyed in a real automobile camping party, where the nights are spent in the open. However, there are some things to be remembered. The automobile is considerably shorter than the motor boat and successful aerial installation on the car is seldom accomplished except for stations only a few miles distant or with quite powerful receiving sets.

This makes it necessary to erect some kind of temporary aerial at each camping place and again we will have to resort to the spool of wire. For this purpose, nothing is better than what is known as a deep sea fishing reel. These come in large sizes and it is possible to wind considerable flexible wire on one. The usual seven strand aerial wire will prove too bulky and it is advisable to get some smaller size.

If a rather heavy sinker is attached to the end of this wire and it is then thrown over the limb of some nearby tree, a suitable aerial will be the result. Except in damp weather, the fact that no insulators are used will make but little difference in the strength of the received signal. Of course it may make a little difference on long distance stations, but for all ordinary work it will prove to be quite satisfactory.

By throwing the sinker over the tree branch and then walking off for fifty or so feet, to the set, a good stretch of wire will be secured. Of course the ground should be made in damp earth, if possible, and a short length of number fourteen wire attached to a length of iron pipe will be sufficient. The pipe should be about two feet in length and driven into the earth for about three-quarters of its length. If you happen to be camping near a body of water, then weight a length of wire and throw it out from the shore.

A careful record kept of the weather during last summer, proved beyond the shadow of a doubt that the nights when really heavy static is heard, are far below the usual idea of the subject. You will find that the good nights average about six out of seven.

This summer is going to be radio from start to finish, and right now is the time to start in your preparations.

The Boy Scouts of America

(*Continued from page 39*)

With the American Morse Code:

1. Commercial telegraph operator.
2. Stock broker operator.
3. Telegraph and telephone engineer.
4. Railroad operator.
5. Train dispatcher.

With the Continental Morse Code or Both:

6. Ship radio operator.
7. Land station operator.
8. Broadcast station operator.
9. Cable operator.

Boy amateurs played one of the most prominent parts in the World War, which found them ready to give their services to Uncle Sam. These boys, many of them, had but a few years previous been Boy Scouts. And, moreover, this great radio we have today (I refer to broadcasting) is likewise directly the results of the vision, enthusiasm and imagination of former Boy Scouts.

For when the boys came back they, as well as the thousands who were taught radio in the Army and Navy, turned once more to amateur experimentation. They added radio telephony to their telegraph experiments and message exchange. They talked back and forth, first only a few blocks, then a few miles and finally from city to city.

It was the boys of the Nation that helped largely to make this great art what it is today. And it goes without saying, of course, that many of these same boys are today leaders in the industry. I know two that are on the road to become millionaires. One of them was once a Boy Scout.

Recently, while on a business trip, I watched the farm houses as the

Pathé

"MINUTE MAN"
Radio Receiving Set
INCORPORATING
Pathé Type "P" Phusiformers

Manufactured and Marketed Under Licensed Agreement, Patent Pending

PRICE
$125.00
(tubes, batteries extra)

THE new five-tube "Minute Man" was specially constructed to meet the demand for a receiving set embodying these features:

No Squeals
Tune in either with a loud speaker or head phones without any squeals or rasping. At any setting of the dials there is none of this unpleasantness so prominent in many other sets.

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train whizzed past and there must have been an aerial on top of every fifth farm house I saw. Now I know enough about the farmer to know that they have not the time to install these sets. Who did it, then? Boys, of course, and many of them got their training in radio through Boy Scout activities.

And now a few words about the meaning of radio to this great Boy Scout movement which today obtains in almost every big nation of the world.

The call to rally has long been sounded by means of the Boy Scout whistle. Its shrill blast has echoed throughout hundreds of camps, and hiking parties have been guided by its note. Yet its feeble signal scarcely reaches the extremities of the camp. Reinforced by the tremendous amplifying ability of a powerful broadcasting station, however, and the same signal will call a nation of listening Scouts to attention. Thus, through the agency of radio, Scouts in cities, villages and hamlets are welded together into a single group, and 500,000 Scouts may hear simultaneously the voice of their leader and Honorary President, the President of the United States.

I believe radio broadcasting will some day accomplish even more than this. Already programs broadcast from the United States reach out to foreign lands. Various refinements in transmission and reception coupled with increased power will bring about reliable broadcasting between such countries as America, France, England. When Baden Powell, speaking from a London station, is plainly heard in all parts of America, and Dan Beard, one of America's leading Scouts, returns a salute from the United States, radio will prove a still more powerful vehicle for promoting the Boy Scout movement.

Of course, there is only one ether, one vast highway, which must support the burden of every conceivable message hurled through space, whether it be a broadcast concert or a radio telegraphic wave. We must use this ether with the utmost respect for the rights of others. This great common highway is divided into "lanes," which are policed by the radio inspectors of the Department of Commerce in the same manner as our automobile and pedestrian traffic on the streets. With the rapid growth in the number of broadcasting stations in the United States, this broad highway had to be divided into many narrow wavelength bands to make a place for all until today few additional divisions are possible. If through selfishness, lack of care or ignorance, amateur operators violate the regulations governing the use of these wavelength roads, the foundation upon which the entire radio structure rests will collapse.

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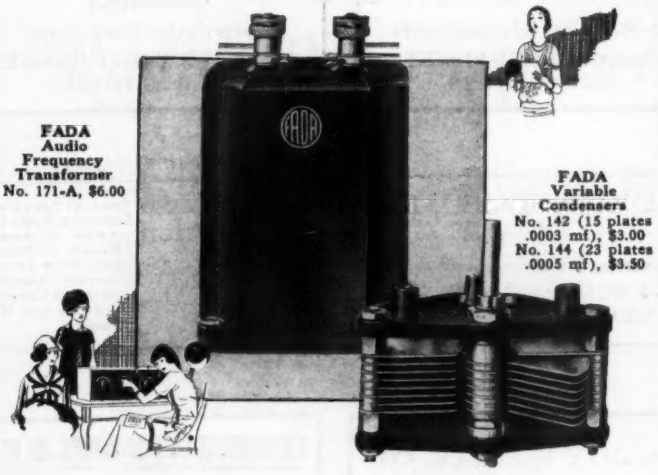

IN KEEPING with its established policy of producing only the finest of radio apparatus, F. A. D. Andrea, Inc., announces a new Audio Frequency Transformer suitable for all circuits, and particularly adapted to the audio stages of Neutrodyne receivers.

A high average amplification over all audio frequencies is the outstanding accomplishment of this new FADA transformer. Encased in bakelite with nickeled binding posts, it looks twice its worth. Try FADA Audio Transformers in your receiver and know what uniform and distortionless amplification really means.

—and now, new variable condensers

The name FADA on a condenser means just one thing—condenser satisfaction. The new FADA condenser is made in two capacities—15-plate, capacity .0003 micro-farads, and 23-plate, .0005 micro-farads; and each the exact capacity at which it is rated. Radio frequency losses are reduced to a minimum by special rotor wiping contact brushes. A true "low-loss" condenser with an efficiency exceeding that of condensers selling at much higher prices.

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F. A. D. ANDREA INC. LICENSED BY INDEPENDENT RADIO MANUFACTURERS INC. NEUTRODYNE

Each listener, amateur and commercial operator has a definite responsibility which he must assume in order to preserve radio's usefulness. The Boy Scouts of America, an organization of 500,000 law-respecting young men, who daily demonstrate their regard for the rights of others and whose loyal devotion to the highest principles of citizenship have won for them the praise of the nation, have an important duty to perform to make radio of greater use to everyone. They should impress upon others the importance of observing strictly radio laws in general; they should instruct or warn those who, through ignorance or design, make trouble for their neighbors by sending amateur messages during the hours set aside for broadcasting, and report cases of violation to their local radio inspector; their advice guided by that of their Scout Masters should even extend into the home of the radio novice, who may not be entirely familiar with the operation of a receiver.

The Boy Scouts of America may thus create another field for their endeavors, which should prove extremely helpful in maintaining a well-organized radio system in America.

Radio in the Canadian Wilderness

(*Continued from page* 41)

As the fire burned out, the embers formed into glowing patterns that seemed to illustrate the broadcast music. Castles and forests, and Mediaeval faces were pictured there.

Even the guides were won over to the radio.

* * *

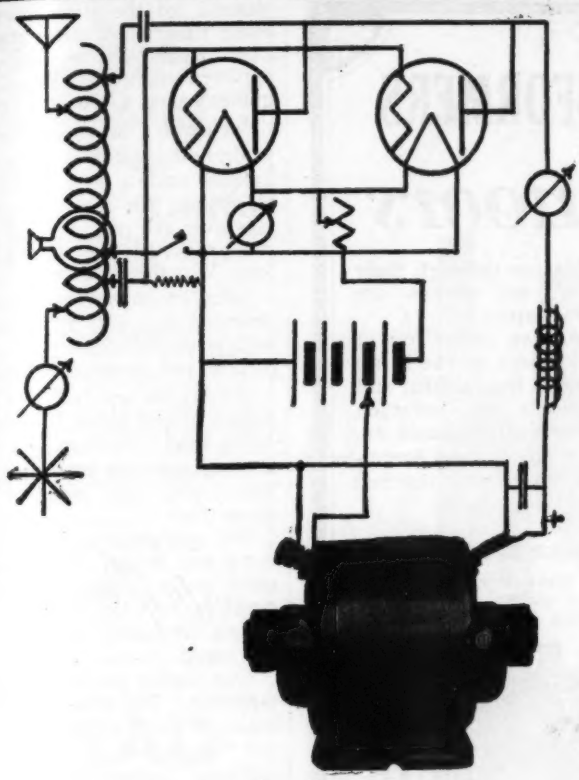
In the morning, we found two salmon and a lake trout spread on birchbark slabs that had been laid on the shore near our canoe.

Jacques explained that the Indian family across the lake had left them as a neighborly greeting. He said that custom forbade anyone going ashore at a camp until an invitation had been given.

Of course, Dr. Hobart and I wished to return the courtesy in some way. Jacques advised us that we should use discretion because the Indians appreciated a small gift; in fact, respected the White Men for their possession of that which the Indians would like to have. But should too much be given, the Indians would invariably demand more, and would very likely take it.

Doc suggested the radio. It was the one thing we could give them in plenty without danger. The Indians couldn't use the set if they did capture it.

A trip to the Indian camp was



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12	1000 V	300	"	dbl.	comm.	2-50 " with separate Fil. supply.
15	1000 V	500	"	"	"	3-50 " or 2-50 watt and 4-5 watt as speech amplifier and mast. osc. Sep. Fil. supply.
16	1000 V	650	"	"	"	4-50 " with separate Fil. supply.
20	1500 V	600	"	"	"	2 to 3-50 " with separate Fil. supply.
24	2000 V	500	"	"	"	1-250 " with separate Fil. supply.
26	2000 V	1000	"	"	"	2-250 " with separate Fil. supply.
31	500 V	100	"	10 V	60	Watt same as item 7 but with Fil. supply.
35	1000 V	300	"	12 V	150	" " " " 13 " " " "
41	2000 V	500	"	14 V	200	" " " " 24 " " " "

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planned for the afternoon so that we could tune in on some broadcast station. During the morning, Doc and I explored the lake shore while the guides baked a blueberry pie.

Incidently, baking in the Northern wilderness is quite an accomplishment. Jacques made a deep bed of live coals, placed the pan over them, raised two logs over the pan, covered them with small rocks and then built a fire on the top. Was the pie good?

Juicy bacon on baked salmon with steaming tea and flap-cakes, topped with luscious blue-berry pie, the twang of pine and spruce in our nostrils!

All day we heard the *tom-tom* of the Indian drums across the lake. It beat in my head. The monotony of it finally aroused pent-up emotions within me that I had never suspected were my inheritance.

We paddled over to the Indian camp and waited just off shore. The chief walked down, saluted, and listened to Joe's explanation. He immediately welcomed us to the bosom of his camp.

Our Indian guide, Joe, acted as interpreter. The tribe we were visiting were, to say the least, incredulous of our "music box."

These Indians travel in family groups of thirty or forty. They are small in stature and resemble Japanese or Eskimos in feature. Tufts of hair protrude from unexpected points about their faces; from each corner of their mouths, usually on the lower lips, or frequently from their cheeks.

Their costumes consist of red toboggan hats, red-top socks, red sash, striped flannel shirts, and usually, khaki riding breeches.

The women are extremely shy. But the children, like all youngsters, stare unabashed.

The Chief had some Kodak pictures of the family that a visitor had left. He brought them for display much in the manner of country folk, showing the unfortunate visitor the family album.

The children learn to carry packs as soon as they can walk. They also have small, half-size canoes. Carrying the tons of supplies from the trading post into the wilderness requires the service of all who can be enlisted.

While the women weave shirts, and prepare dried fish and meats, the men relay the supplies over the portages. They work hard on the portages—terribly hard. But they otherwise take life as it comes, leaving most of the responsibilities to the women.

When I managed to tune in CKAC, the Indians were delighted. Singing, talking, orchestral music—inconceivable!

Late into the night we celebrated.

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CHICAGO

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Chasing Squeals

(*Continued from page 59*)

If you have a filament volt meter take a glance at the voltage which you have across the terminals on the socket. You will note that with each tube there is a specified voltage for the filament at which this tube works best. In the case of WD-11's and WD-12's this voltage is 1-10th, with UV-199's it is exactly three volts and with 201-A's it varies from 4½ to 5 volts. Now in no case is the voltage of your battery exactly that which is applied to the filament terminals, or rather we should say that the voltage of your battery never reaches the tube intact. This is due to poor connections, resistance of wires, etc., which are beyond your control in most cases. So it becomes necessary to use a higher voltage battery than is necessary to feed the tubes at the socket terminals. For the WD-12 we use 1½ or 2 volts supply and cut it down by means of a rheostat in series. For UV-199's we have four volts or 4½ which we cut down to three and in the case of a UV-200 and 201A we have an initial voltage of six which we cut down to five. But the trouble is, we very often do not cut it down to the proper voltage but allow our eyes to tell us how bright the tube should light up.

Unless you have had some experience in this manner of telling the correct voltage we do not recommend it. The hard tubes now on the market today are discolored to such an extent that one is barely able to tell whether the tube is lit or not and at best, it is not a safe method. With a D. C. filament volt meter reading from 0 to 5 or 0 to 7 volts you will be better able to regulate your tubes and their proper voltages and at the same time secure much better results and lengthen the lives of the tubes. Over-loading the filament of a vacuum tube decreases its life alarmingly. On one type of tube in particular an increase of 3 per cent over the rated filament voltage cuts the life of the tube one-half. A 3 per cent decrease below the rated filament voltage will more than double the life of the tube. So you see it is quite worth the initial outlay of $7 or $8 for a good reliable filament volt meter to know exactly what voltage you are putting on your tubes.

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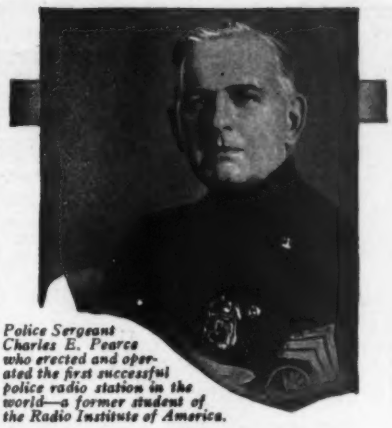

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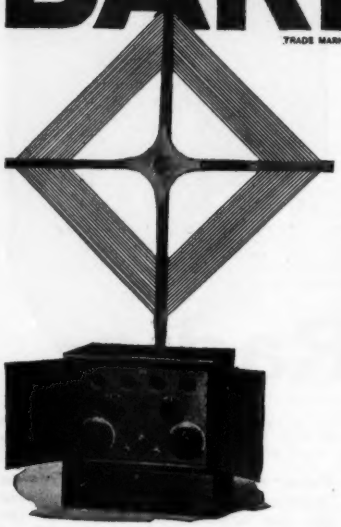

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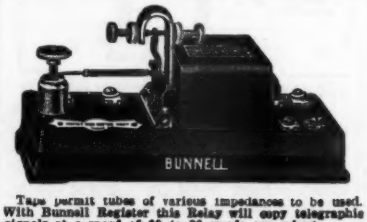

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Special Price to Dealers
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Radio Frequency Circuits

(*Continued from page 64*)

ohms resistance is very imperative in most radio frequency circuits, and should by all means be used. The potentiometer is greatly needed to keep the set out of oscillation.

Adding Radio-Frequency to Regenerative Sets

The diagram in figure 2 shows another experiment made in adding radio-frequency ahead of a twin variometer regenerative set of standard type. The aerial was coupled through a variable condenser and tuning coil or primary of a coupler, as shown, and this circuit fed into the input of the radio-frequency set. The transformer lead to the plate terminal on the third radio-frequency stage was opened and a wire secured to the socket plate terminal, and this then led to a variable condenser shunted across the primary of the vario-coupler in the twin variometer regenerative set. It is advisable to also have a variable condenser of the 23 or 43-plate type (an 11 or 23-plate is usually found sufficient, unless the rotor of the vario-coupler has but a few turns of heavy wire on it) connected across the secondary to give sharper tuning. This circuit works all right with one or two stages of radio-frequency in use, but as will be apparent, one of the main objections to it is that there are too many controls. One advantage which might be imagined for this circuit would be that along with the use of the radio-frequency, there would be a gain of strength in signals, due to the regenerative action caused by the use of the variometers, etc., but as pointed out by several radio engineers and as actual experience has proven, there is a suitable regenerative action, or the equivalent of it, through the use of several stages of transformer coupled radio-frequency, and this is found to be equivalent or nearly so to the effects produced by using a regenerative detector circuit, as shown in figure 2. One more thing to be mentioned in connection with figure 2 is that if a variable condenser B is used across the secondary of the vario-coupler, the grid variometer may then be omitted.

In figure 3 is shown one method of connecting one stage of radio-frequency to a standard regenerative set. A 23 or 43-plate condenser may be connected across the aerial or ground posts and primary of the vario-coupler in the set as shown, but some radio experimenters have found this to be unnecessary, much depending upon the general design of the regenerative set employed. The writer prefers the use of a variable condenser across the primary of the vario-coupler; in any case

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THE SCIENTIFICALLY CORRECT RADIO RHEOSTAT

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The best text book on the market devoted solely to the various applications of the Oscillation Valve

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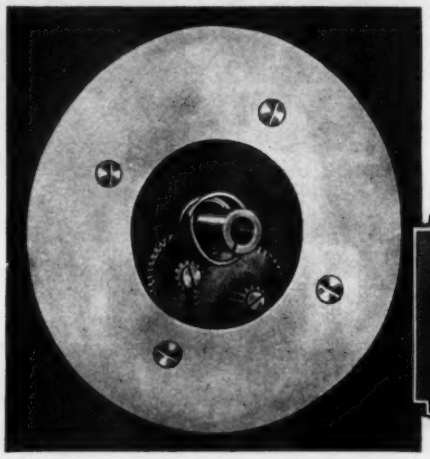
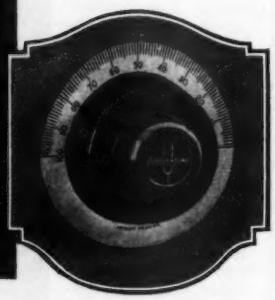


PRECISION
a case of
gear ratio



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it gives greater selectivity and much sharper tuning in every respect. The aerial tuning inductance may be either a tuning coil, a honeycomb coil of fifty to seventy-five turns, or a tapped inductance such as the primary of an old coupler, or else a coil wound with about seventy-five turns of No. 22 insulated magnet wire with switch taps taken off about every ten turns.

Amplifiers

(*Continued from page* 61)

times as great as the tube resistance, then it will be more than that at all other frequencies above it. But from our chart in figure 3 we see that when this is the case we obtain full amplification at all frequencies above 50 cycles and thus have no distortion. Thus the trick is to make the inductance L in figure 2 very great. A good value for L when used with such standard tubes as UV-201A or UV-199, is about 50 henries or over. Now this is a very large inductance and not easily built. It requires a great many turns on an iron core. For this purpose it is therefore suggested that the secondary of an audio frequency transformer be used for this purpose as it has the necessary inductance.

Such an amplifier, when it has choke coils of the high values given above, will give as good quality of speech and music as a resistance coupled amplifier. It is free from distortion. It has the added advantage that it requires less plate battery voltage, since the resistance of the choke coil is much less than the resistances used in resistance coupled amplifiers.

Radio Frequency

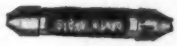
A radio frequency inductance coupled amplifier is a much more difficult proposition. The reason for this is that the inductance has distributed capacity, and this distributed capacity will by-pass the radio frequency. That is, the radio frequency currents will rather flow through the distributed capacity than through the inductance, and hence amplification will be sacrificed. Another difficulty is that multistage radio frequency inductance coupled amplifiers are unstable; that is, they have a tendency to oscillate, which results in poor quality speech and music and also decreased amplification. This type of radio frequency amplifier is to be avoided, for it becomes very difficult to handle, and one does not want to be under the necessity of continually having to be on watch and adjusting controls, especially when listening to concerts or speeches. This is not recommended therefore and will not be discussed.

An Expert Says:

Resistance Coupled Amplification!

G. Y. Allen, of the Westinghouse Electric and Manufacturing Co., writes in the May *Radio Broadcast:*

"True, great improvements have been made, but the fact remains that fundamentally the transformer cannot ever give distortionless amplification. For those who demand quality at all cost, the resistance coupled amplifier is unquestionably the most desirable."



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Ask your dealer—or let us help you out.

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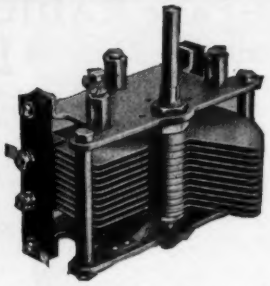

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Afloat and Ashore With the Operator

(*Continued from page* 53)

A recent issue of "Shipping Register," published in San Francisco, contained an interesting article about Arthur A. Isbell, now manager of the Pacific division of the Radio Corporation, and Lawrence A. Malarin, now district sales manager, in bridging the gap between Hawaii and the mainland of the United States when Mr. Isbell sent and Mr. Malarin received the first wireless message transmitted between those two points, in the year 1908.

The article also gives Mr. Isbell the credit of publishing the first wireless newspaper on the Pacific. This was in 1907 while he was operator on the *President*, since renamed the *Dorothy Alexander*.

Hundreds of messages now pass daily between San Francisco and Hawaii with less thought and trouble than that one eventful communication back in 1908.

High Lights in Radio Development

(*Continued form page* 71)

an instrument capable of this indicates the supreme care necessary in manufacture.

To eliminate entirely the human equation in matching the tone of the receivers, the Brandes company has installed a battery of ingenious supersensitive instruments to do this. These are so arranged that the receivers are tested both for volume and sensitivity, a needle on the dial giving the readings, and in addition indicates any grounds that may be present. The receiver is made to produce a note the same as that produced by a receiving set, and this note is picked up and recorded visually by a needle over the dial. The readings must be within certain limits, and those receivers showing the same characteristics are put in a box with others which registered similarly, later to be placed in pairs in headsets.

The illustration shows C. E. Brigham, chief research engineer of the Brandes Company, using the visual test machine.

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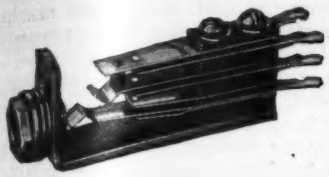
Nothing was heard from him all



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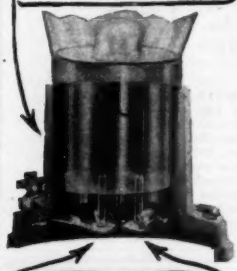

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during the cold, still, winter months, but when the warmer weather loosened up the ways and he again journeyed to the post with his furs, he immediately looked up the man from whom he purchased his radio outfit. The Frenchman was jubilant! He told of his little log cabin on the hill above the lake; how he would hurry from his toil among his traps to the now cheery little home where, during the long, dark evenings, he and his wife (for he was married now), could listen to beautiful concerts broadcast from Montreal, and to news from the outside world.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of the Wireless Age, published monthly at New York, N. Y., for April 1, 1924.

State of New York } ss.
County of New York }

Before me, a notary public, in and for the State and county aforesaid, personally appeared H. H. Reber, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Wireless Age and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Wireless Press, Inc., 326 Broadway, New York, N. Y.

Editor, Jerome W. Howe, 326 Broadway, New York, N. Y.

Managing Editor, None.

Business Manager, H. H. Reber, 326 Broadway, New York, N. Y.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent. or more of the total amount of stock should be given.)

Wireless Press, Inc., 326 Broadway, New York, N. Y.

Radio Corporation of America (owning all the stock of Wireless Press, Inc.), 233 Broadway, New York, N. Y.

The names and addresses of stockholders of Radio Corporation of America owning or holding 1 per cent. or more of the total amount of its stock are as follows: Cameron Blaikie & Co., 44 Broad St., N. Y. C., General Electric Co., 120 Broadway, N. Y. C., International Radio Tel. & Tel. Co., 165 Broadway, N. Y. C., United Fruit Co., 131 State St., Boston Mass.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is.....
(This information is required from daily publications only.)

H. H. REBER,
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Sworn to and subscribed before me this 20th day of March, 1924. M. H. PAYNE.
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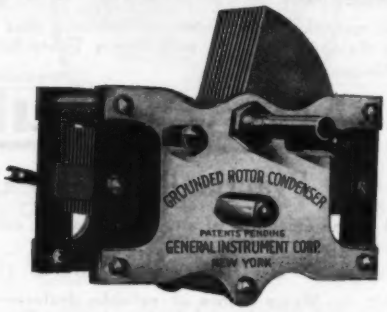

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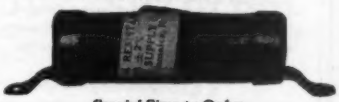

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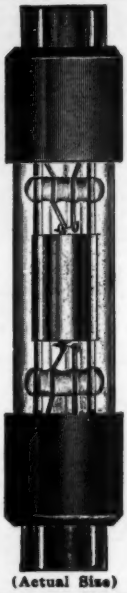
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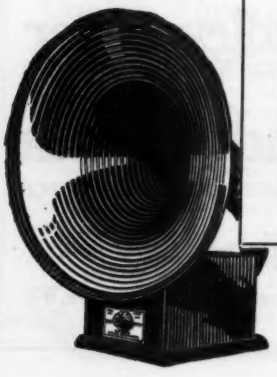

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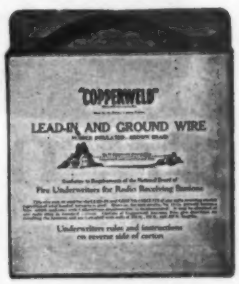

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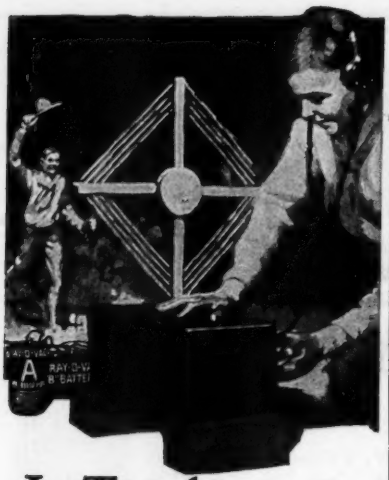

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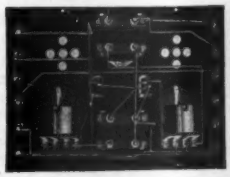

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2 ARB John Hartnett, 61 E. 122nd St., New York, N. Y.
2 OS Charles S. Hallock, 5710 4th Ave., Brooklyn, N. Y.
2 CWU Joseph A. Hefele, 1376 Leland Ave., New York, N. Y.
2 CQM George Peter Cole, 229 Lepew St., Peekskill, N. Y.
2 CIL M. Eugene Bussey, 16 Cedar Pl., Yonkers, N. Y.
2 BB Isaac R. Louisberry, Lorraine St., Mamaroneck, N. Y.
2 BID Fred Clorpik, 23 Waltham St., Jamaica, N. Y.
2 ARW Edward W. Herold, 55 Kenmore Ave., Newark, N. J.
2 APG Robert Talbert DeCamp, Jr., 122 Central Ave., Newark, N. J.
2 CO Walter A. Cobb, 178 South Main St., Orange, N. J.
2 ARM Louis Machlerioli, 301 17th St., West New York, N. J.
2 CI Andre LeMour Merle, 740 Center St., Dunellen, N. J.
2 CY John W. Swanson, Pocantico Hills, N. Y.
2 APP George B. Hyatt, 132 Chambers St., Newburgh, N. Y.
2 APD Theodore R. Adams, 104 Lynch St., Brooklyn, N. Y.
2 PI Clifford H. Hamill, 176 Highland St., Port Chester, N. Y.
2 ART Union College Radio Club, College Campus, Union College, Schenectady, N. Y.
2 AEX Rudolph E. Leppert, 53 Campbell Ave., Belleville, N. J.
2 AMG Frank W. Hooton, 636 Grier Ave., Elizabeth, N. J.
2 CPV Donald B. Templeton, 346 Union Ave., Lynbrook, N. Y.
2 AEL William Schwartz, 1621 78th St., Brooklyn, N. Y.
2 BQA Burt Toegel, Victoria Ave., New Market, N. J.
2 CXP David M. Unger, 1277 E. 10th St., Brooklyn, N. Y.
2 AEN William T. Golden, 680 West End Ave., New York, N. Y.
2 CIS William Macdonald, 128 De Hart Ave., Mariner's Harbor, N. Y.
2 EW Lloyd G. Scott, 2044 8th Ave., N. Y. C.
2 AEU Edward S. Read, 125 Hudson Ave., Ridgefield Park, N. J.
2 EV John B. Kilpatrick, 206 W. 69th St., N. Y. C.
2 AFJ Alden W. Smith, 218 Christopher St., Montclair, N. J.
2 AEY Raymond E. Groebe, 338 El Mora Ave., Elizabeth, N. J.
2 AFW George Gathman, 32 Delaware St., Elizabeth, N. J.
2 AFX Henry K. Juelch, Jr., Englishtown, N. J.
2 AFB Arthur M. Tyte, Jr., 767 E. Main St., Riverhead, N. Y.
2 FL William P. Schweitzer, 115 Eastern Parkway, Brooklyn, N. Y.
2 ED Charles F. H. Johnson, Jr., 136 High St., Passaic, N. J.
2 AGL Henry L. Kimmig, 640 52nd St., Brooklyn, N. Y.
2 AGF Arthur Johnson, 53 Campbell Ave., Belleville, N. J.
2 CXP David M. Unger, 1277 E. 10th St., Brooklyn, N. Y.
2 CVV Edward Johnstone, 1190 Broad St., Newark, N. J.
2 JA David Carruthers, 138 Dyckman St., New York, N. Y.
2 CM Cornelius C. Vermeule, Jr., 63 Harrison St., East Orange, N. J.
2 AFZ William R. Edwards, Fort Slocum, N. Y.
2 CBJ Henry A. Stainken, 558 Broadway, West Brighton, N. Y.
2 SK William Woodrow, N. Y. Vocational School for Boys, 138th St. and 5th Ave., N. Y. C.
2 BVG John V. Priante, 836 Lefferts Ave., and Utica Ave., Brooklyn, N. Y.
2 CO Walter A. Cobb, 178 So. Main St., Orange, N. J.
2 DM Ernest A Meinecke, 2837 Boulevard, Jersey City, N. J.
2 CX Theodore L. Van Loan, 31 Prospect Ave., Catskill, N. Y.

Third District

3 AW Dwight M. Williams, 40 Jefferson Ave., Haddonfield, N. J.

Eighth District

8 AAD Earl G. Benedict, 19 No. St., Cobleskill, N. Y.
8 AAM John C. O'Conner, 28 Cumberland St., Rochester, N. Y.
8 ABU Latimer L. Charmicky, 10214 Mt. Auburn Ave., Cleveland, O.
8 ACQ Wolcott B. Louis, 1252 Summit Ave. Lakewood, O.
8 ACS Warren R. Cox, 902 Pierpont Ave., Cleveland, O.
8 ADH Frederick W. Maucell, Jr., Pittsburgh St., Springdale, Pa.
8 ADL Fred L. Bremer, 89 S. Judson St., Gloversville, N. Y.
8 ADZ Carlton Davis, 333 Pearl St., Coldwater, Mich.
8 AEE Osborn F. Myrick, 3163 Clinton St., Olean, N. Y.
8 AHH Amor Wm. Bues, 1092 Timerman Rd., Columbus, O.
8 AJR J. Lee Kidion, 924 E. 237th St., Noble, O.
8 AJV Wm. L. Jackson, 80 Burlingame Ave., Detroit, Mich.
8 AOG Ronald E. Fuller, 219 River St., Ypsilanti, Mich.
8 AOR James D. Bobb, Jr., 207 Allen Blvd., Kalamazoo, Mich.
8 AOS Edward L. Sharp, 151 Chapin St., Binghamton, N. Y.
8 AOT Carl Rossback, 15 S. McNab Ave., Gloversville, N. Y.
8 AOU Charles G. Thomas, 2515 Braddock Ave., Swissvale, Pa.
8 ATS Arthur J. Scholtz, 801 Elm St., Saginaw, Mich.
8 BAZ Harold Teegarden, 219 So. Lincoln Ave., Alliance, O.
8 BEJ Ray M. White, North Clay St., Millersburg, O.
8 BGH Donald T. Page, 1304 Granger Ave., Ann Arbor, Mich.
8 BHI Lynn Erratt, 325 N. Huron St., Sheboygan, Mich.
8 BIQ J. M. Smith, 2315 Lawrence Ave., Toledo, O.
8 BJZ Harold Knubbe, 2514 Chalmers St., Detroit, Mich.
8 BKR John T. Kunkle, 326 W. Columbia St., Alliance, O.
8 BKZ Geo. E. Munschauer, 27 Dodge St., Buffalo, N. Y.
8 BNU Harry Kuhlemeier, 1206 Fischer St., Detroit, Mich.
8 BQW Clark B. Kemp, 29 Reading Ave., Hillsdale, Mich.
8 BSS Aloysius I. Wolf, LaRue, O.
8 CLN Thomas Doddridge, 348 Florida Ave., Buffalo, N. Y.
8 CPQ Jesse F. Hurley, 514 Buckeye St., Hamilton, O.
8 CSQ Ora George, 926 Sandusky St., Findlay, O.
8 CZR Fred R. Smith, 329 W. Broadway St., Alliance, O.
8 DGB Anthony Raymond, 648 Jay St., Utica, N. Y.
8 DLK Peter J. Koole, 44 Stomzand Pl., Grand Rapids, Mich.
8 DNA Ralph E. Kepler, 229 W. 52nd St., Cleveland, O.
8 DNK Charles E. Holmes, 310 W. Brown St., Grand Rapids, Mich.
8 DNV Clark Minor S. Clark, 1948 Hewitt Ave., Cincinnati, O.
8 DNW Joe Trimbur, 713 Fenton St., Niles, O.
8 DNY Basil V. White, 418 Fraser St., Bay City, Mich.
8 DOL Walter Malone, Victor, N. Y.
8 DOO Robt. L. Miller, 328 W. Hudson St., Royal Oak, Mich.
8 DOU Charles F. Henlka, 436 Mitchell St., Petoskey, Mich.
8 DOY Edwin E. Hare, 336 Douglas St., Wilmington, O.
8 DOW Robt. S. Brown, 521 Paris Ave., S. E., Grand Rapids, Mich.
8 DOX Amos E. Feightner, R. F. D. No. 3, Box 4, Elida, O.
8 DOY Fred Williams, 109 Broadway Ave., Harrison, O.
8 DOZ Charles Werkman, Cor. 4th and Walnut Sts., Irwin, Pa.
8 DPA Wm. A. Hunt, Jr., 1610 Creston Rd., Cambridge, O.
8 DPB Robt. R. Woodruff, R. F. D. No 2, Havana, O.
8 DPC Alex H. Hood, Isabella Rd., Box 776, Connellsville, Pa.
8 DPD Harry L. Barnes, 506 Cherry St., Galion, O.
8 DPE F. M. Louwaert, R. R. No. 1, Burke Acres, Kalamazoo, Mich.
8 DPF Walter E. Kinney, 572 Wilson Ave., Marion, O.
8 DPG Carrol A. Wilson, R. F. D. No. 1, Adrian, Mich.
8 DPH John J. Barney, 519 W. Market St., Mahanoy City, Pa.
8 DPI Ray Hall Holmes, 1013 Ross Ave., Wilkinsburg, Pa.
8 DPJ Francis J. Paulus, 399 Nash St., Akron, O.
8 DPK Charles W. Lewis, Jr., Walloon Lake, Mich.
8 DPL Raymond Griswold, 1067 West Ave., Buffalo, N. Y.
8 DPM Bruce A. Parlette, 13441 Emerson Ave., Lakewood, O.
8 DPN Carl Keske, 2309 Corning Ave., Cleveland, O.
8 FT Howard S. Pyle, 1237 Montclair Ave., Detroit, Mich.
8 HP Boy Scouts of America, Troop No. 1, 640 W. Jackson St., Painesville, O.
8 MV Floyd A. Hansen, 990 Jennings St., Benton, Mich.
8 OR Floyd D. Becker and Lynn Robbins, Collings Center, N. Y.
8 PE Stewart B. Taylor, Jr., 742 Main St., Stroudsburg, Pa.
8 QK University of the City of Toledo, Nebr. and Blvd., Todelo, O.
8 QO Robt. J. Neff, R. F. D. No. 1, New Carlisle, O.
8 SC Francis J. Humphreys, 328 Center St., Ionia, Mich.
8 VQ Horace H. Crow, 26 Cheltenham Dr., Buffalo, N. Y.
8 WL Louis J. Schneider, 2144 W. 93rd St., Cleveland, O.
8 AAI Geo. W. Davis, 313 Prendergast Ave., Jamestown, N. Y.
8 AAN Elmer Brownell, 1007 Lamb St., Utica, N. Y.
8 AAV Lester E. Clark, 40 Bentley Ave., Hubbard, O.
8 AAX W. F. Ehrich, 310 Lexington St., Mansfield, O.
8 ABD Arthur Menkhaus, 1850 Westwood Ave., Cincinnati, O.
8 ABE B. C. Fidler, 631 Parrish St., Uhrichsville, O.
8 ABR G. Rouston, 1053 Chalmers Ave., Detroit, Mich.
8 ABX John J. Long, Jr., 205 Prospect St., Canandaigua, N. Y.
8 ACG G. H. Hammer, 407 Franklin Ave., Vandergrift, Pa.
8 ACH John A. Victoreen, 1906 E. 93rd St., Cleveland, O.
8 ACL Wm. F. Agee, 841 4th St., Portsmouth, O.
8 ACN Warren J. Root, Butternut Ridge, No. Olmstead, O.
8 ACO Philip J. Robischung, 1413 N. Edward St., Kalamazoo, Mich.
8 ACP Hill Top Y. M. C. A., Pittsburgh, Pa.
8 ADM Wm. L. Rust, 410 W. Seneca St., Ithaca, N. Y.
8 ADQ Horace Gilman and W. Boberts, 8933 Quincy Ave., Detroit, Mich.
8 AEG Ererett L. Knapp, 1190 Phila. Ave., Detroit, Mich.
8 AEQ John N. Patterson and Jos. Andersen, 1346 E. 114th St., Cleveland, O.
8 AJE Clyde W. Champness, 4433 W. 49th St., Cleveland, O.
8 AJN S. F. Kruper, 230 Second St., West Newton, Pa.
8 BCD T. L. Cramer, 4233 Rocky River Dr., Cleveland, O.
8 BHM C. R. Roy Phillips, 9 Grand View Park, Canandaigua, N. Y.
8 BK H. C. Squires and A. P. Typer, 2065 E. 79th St., Cleveland, O
8 BPV W. R. McShaffrey, care of Star Theatre, Monessen, Pa.
8 BVN Gilbert E. Mears, 910 Kirby W., Detroit, Mich.
8 CAE B. M. Baldwin, 944 No. Union St., Fostoria, O.
8 CI Wm. H. Marshall, 1409 Orchard Grove, Lakewood, O.
8 CLM John W. Hill, 95 Lida St., Mansfield, O.
8 CPY James A. Wilson, 911 Lay Blvd., Kalamazoo, Mich.
8 DDR Ralph Harris, 505 Pleasant St., Grand Ledge, Mich.
8 DIK Frank Gibbs, New Hartford, N. Y.
8 GC W. G. Chandler, 6502 Erie St., Sylvania, O.
8 LG Lester W. Kimley, 290 Winslow Ave., Buffalo, N. Y.

SPECIAL AMATEUR

8 ZO Charles Gault, 329 Maple St., Ypsilanti, Mich

EXPERIMENTAL

8 XBW A. H. Foreman, West Virginia University, Morgantown, W. Va.
8 AJK Ralph R. Davis, 118 Ridge St., Parsons, Pa
8 AJR J. Leo Didion, 924 East 237th St., Noble, Ohio
8 AJZ Edgar R. Robinson, 1013 Vine St., Sandusky, O
8 AKH John Louis Kramer, 1833 No. View Rd., Rocky River, O
8 AKK Peter Contant, 42 Akron St., Rochester, N. Y.
8 BDK Cyril J. C. Schmidt, 4225 Brownway Ave., Oakley, Cincinnati, O
8 BEA Charles C. Chamberlain, 205 Seminary St., Bearea, O
8 BGA Wm. P. Siegman, Jr., 147 Farnum St., Royal Oak, Mich
8 BK H. G. Squires, 2065 East 79th, Cleveland, O.
8 BKT Dean H. Elliott, 33 So. Gordon St., Governour, N. Y.
8 BLM Ellsworth J. Speicher, 429 George Ave., Parsons, Pa
8 BN Paul M. Barnes, 3321 Blanchard St., Toledo, O
8 BNL Fredrick C. Snider, 35 East 219th St., Euclid, O
8 BNU Jacob N. Turner, 415 Holt St., Dayton, O.
8 BOH Robert W. Mallett, 316 Cooper St., Utica, N. Y.
8 BOO Howard George, 215 Pike St., Dunkirk, N. Y
8 BOW Henry L. Carter, 477 N. Goodman St., Rochester, N. Y.
8 BOX Raymond C. Gilbert, 500 South Garfield St. East Rochester, N. Y
8 BPB Harrey G. Noah, R. F. D. 1, Lodi, O
8 BPF James R. Merritt, Sprague ville, N. Y.
8 BPH John B. McClure, 139 Shore Line, Wickliffe, O
8 BPI Samuel C. Fusco, 104 Fulton St., Niles, O
8 BPM Wm. N. Terrill, 1100 Steuben St., Utica, N. Y.
8 BPW Ansonia High School, West Canal St., Ansonia, O
8 BQW Clark R. Kemp, 29 Reading Ave., Hilldale, Mich
8 BQY Byron S. Roudabush, 520 Front St., Minersville, Pa.
8 BRV Charles G. Williamson, 128 North 4th St. Trenton, Mich
8 BRX Edward Stanko, 235 Hudson St., Buffalo, N. Y.
8 BSP Woodruff G. Evans, 707 No. Madison St., Rome, N. Y
8 BST Clyde N. Fuller, 4078 Tireman St., Detroit, Mich
8 BTN Z. M. Poling, Scottdale, Pa
8 BTS Wm. T. Burlingame, 72 Tremaine St., Kenmore, N. Y.
8 BYT Maurice W. Tyer, 319 So. Capitol Ave., Lansing, Mich
8 CCJ Robt. T. Schlandecker, 450 West Fourth St., Erie, Pa.
8 CGF Steve Fridrick, 421 Ohio Ave., Midland, Pa.
8 CKL Francis A. Edwards, 291e Putnam St., Detroit, Mich
8 COK W. A. & H. L. Mulligan, 2038 Genesee St., Utica, N. Y
8 CPC L. Selye Whitmore, 47 Vick Park B., Rochester, N. Y
8 DFE Grant Scheufler, 1406 Clinton St., Sandusky, O
8 DFS Frank F. Lehman, R. F. D. 1 Box 21, St. Joseph, Mich
8 DHH Orson M. Buck, 206 Arthur St., Utica, N. Y
8 DMJ Rupert Bents, R. F. D. 4, Parkersburg, West Va
8 DNI Lester Raymer, 2103 S. Burdick St., Kalamazoo, Mich
8 DNJ William A. Graver, Washington St., Wilkes-Barre, Pa
8 DN8 Kimmel A. Sylvester, 4523 Freindship Ave., Pittsburgh, Pa
8 DNT Robt. D. Mitchell, 401 W. Chestnut St., Barnesville, O
8 DNU Burdette Haley, 606 Chestnut St., Irwin, Pa
8 DNY Basil White, 418 Fraser St., Bay City, Mich
8 DNX Pearl A. Ewell, P. O. Box 93, Milan, O
8 DNZ Verne L. Wilde, Hamilton, N. Y

8 DOA Howard Scheer.....Lyons, N. Y.
8 DOB Anthony Raymond.....648 Jay St., Utica, N. Y.
8 DOC DeVaine Swigart..904 Kenmore Blvd., Kenmore, O.
8 DOD Lawrence H. Wise, Jr.....226 So. Cherry St., Van Wert, Ohio
8 DOE Fred W. Albertson.....Fairgrove, Mich.
8 DOF Karl V. Rettstatt, 643 Howard St., So. Brownsville, Pa.
8 DOG Edgar A. Hike..1708 Charles Ave., Kalamazoo, Mich.
8 DOH Ishmael B. Anderson..1011 W. Pittsburgh, Scottdale, Pa.
8 DOI Donald M. Swentzel, 1733 3rd St., Huntington, W. Va.
8 DOJ Samuel D. Frailick, 422 E. State St., Cheboygan, Mich.
8 DOK Gilbert Burrell...420 S. Logan St., Lansing, Mich.
8 DOM Fabian Stroh, 3349 Woodbridge Ave., Cleveland, O.
8 DON Raymond Donaldson..11 Park St., Amsterdam, N. Y.
8 DOP Thomas D. Johnson..S. Main St., Lake Odessa, Mich.
8 DOQ Charles A. Weaver, Penna, Ave., So. Huntington, Pa.
8 DOR Harry A. Hagler.....R. F. D. 9, Xenia, Ohio
8 DOS Edward B. Darnall..20 Fargo Ave., Ashtabula, Ohio
8 DOT Stanley McMillan..3612 Carey Ave., Kenmore, Ohio
8 IK Geo. Belprez.....2552 Newport Ave., Detroit, Mich.
8 TA Raymond E. Hawring, 6808 Gratiot Ave., Detroit, Mich.
8 UI Albert E. Flemming, 2813 Brooklyn, Ave., Detroit, Mich.
8 WB West Penn Radio Club, Crawford Ave., Connellsville, Pa.

CHANGES OF ADDRESSES

8 ACN Warren J. Root, Butternut Ridge, North Olmstead, Ohio
8 APO Eugene A. Fattey, R. F. D. 3, Springville, N. Y.
8 BAH Harry A. Tummonds, 1478 Wagar Ave., Lakewood, Ohio
8 BFF Robt. J. Hunter, 6 Costello Park, No., Rochester, N. Y.
8 BFE Andrew Noaker....1464 Western Ave., Toledo, Ohio
8 BWN Richard L. Dyer..428 Peach Ave., Point Pl:. Toledo, Ohio
8 CYI Joseph M. Hertzberg, 1376 Dewey Ave., Rochester, N. Y.
8 DEF John B. Allen.....68 College St., Clinton, N. Y.
8 OJ Norman Schlaack, 423 Ridgedale St., Birmingham, Mich.
8 UDC K. Mawby.....1000 Pitken Ave., Akron, Ohio

EXPERIMENTAL

8 XBU Dept. of Elec. Engineering, Michigan Agricultural College, East Lansing, Mich.

SPECIAL AMATEUR

8 ZN Walter H. Volger, 117 Lafayette Blvd., Detroit, Mich.

Ninth District

9 HD Lake Forest University.....Lake Forest, Ill.
9 JL Iowa State Teachers College, 24th and College Sts., Cedar Falls, Iowa
9 KQ David C. Smith....12108 Parnell Ave., Chicago, Ill.
9 LU Armory Radio Club..209 N. Main St., Fairmont, Minn.
9 MR Gerard McL. Cole..4125 Greenview Ave., Chicago, Ill.
9 NL Frank W. Arnoldus..2719 S. 10th St., Omaha, Nebr.
9 OJ Radio Electrical Exp. Club, Third Ave., Baraboo, Wisc.
9 TE Clifford Chilson..7425 S. Shore Drive, Chicago, Ill.
9 TZ Harry Z. Wilson....1126 S. 31st St., Omaha, Nebr.
9 WN James P. Beland, 1st Lt. 3d F. A., Ft. Benj. Harrison, Ind.
9 BLP Wilson Thomas.....704 W. 5th St., Cameron, Mo.
9 CEF Herbert B. Settle, 403 E. Burkhart St., Moberly, Mo.
9 CFO Theodore Lange, 808 N. Division St., Appleton, Wisc.
9 CTA Elmer Lemke..892 Commercial St., Appleton, Wisc.
9 CVU Frank J. Bruce....603 Pine St., Chisholm, Minn.
9 CWH Louis E. Deehant....100 S. High St., Belleville, Ill.
9 CXR Frank W. Jenkins..8666 Vernon Ave., St. Louis, Mo.
9 DBL George W. Birdsall, 121 Washington St., Hampton, Iowa
9 DOM Leonard Holets.....Swisher, Iowa
9 DUO Kenneth C. Shirk, 2407 Evans St., Omaha, Nebr.
9 DXO Ralph Atlass.....7421 Sheridan Rd., Chicago, Ill.
9 DYD Paul D. Cooley.....321 Scott St., Ripon, Wisc.
9 EAJ Arthur Essman....105 W. Oak St., Red Oak, Iowa
9 EAW Karl Everett.....R. F. D., Cameron, Mo.
9 EAZ Lester Wagner...1468 E. Main St., Belleville, Ill.
9 EBO Urban A. Weiler, Box No. 12, R.F.D. No. 2, Burlington, Wisc.
9 EBP Clair R. Ditto.....Seaton, Ill.
9 EBU Weir L. Strayer.....Wagner, S. Dak.
9 EBW John W. Blessing....Wefel St., Fennimore, Wisc.
9 EBX Louis E. Ludke....158 N. 7th Ave., Ft. Dodge, Iowa
9 ECK Marcus C. Kronauer, 2521 White St., Marinette, Wisc.
9 ECP Reniff F. Brown.....Wenona, Ill.
9 EDC Donald E. Powers, 1516 Woodland Ave., Des Moines, Iowa
9 EDX Leonard H. Loufek, 1346 S. Fourth St., W., Cedar Rapids, Iowa
9 EEY Merwyn A. Russell..109 E. 7th St., Rushville, Ind.
9 EFM Harold M. McNiff, 302 S. Manhattan Ave., Manhattan, Kans.
9 EFR Laurence A. Dean, 104 N. Raymond S., Marinette, Wisc.
9 EGY Gilbert D. Jackson.....Box 147, Galatia, Ill.
9 EGZ Robert W. Freitag.....Preble, Ind.
9 EHK Francis P. Shirley, 1021 S. Harrison St., Sedalia, Mo.
9 EHU John S. Windt, 2520 Maple Pl., Ft. Wayne, Ind.
9 EIC Howard P. Dickover, 1706 E. 37th St., Kansas City, Mo.
9 EJJ Ralph F. Haupt, 306 Sycamore St., Peabody, Kans.
9 EJO John B. Lininger, 273a Meade Ave., Ft. Leavenworth, Kans.
9 EKI Edwin Rinehart...411 E. Scott St., Kinksville, Mo.
9 AY Paul D. Meyer.....3702 Prairie Ave., Evanston, Ill.
9 DH York Community High School.....Elmhurst, Ill.
9 DZ Kempster W. Pyle, 256 Greenwich St., Valparaiso, Ind.
9 HE Lorenz D. Smith, 5116 S. Harriett Ave., Minneapolis, Minn.
9 LK Clarence H. Powell, 915 S. Western Ave., Mexico, Mo.
9 MI Herman B. Hanson, 340 Lincoln St., Longmont, Colo.
9 MK Chambers Island, Inc.....Fish Creek, Wisc.
9 MX Louis A. Wellaeger, care of Lakeside Hotel, Pewakee, Wisc.
9 OP Francis J. McGrail, 4031 Brighton Pl., Chicago, Ill.
9 PM James Schultz.....511 W. Gale St., Angola, Ind.
9 ACK Lee Weng.....516 Front St., Jamestown, N. Dak.
9 ADO Clarence Hayward, 509 N. Henry St., Savannah, Mo.
9 AFC Robert G. Starrett, 1009b E. Eighth St., Sheldon, Ia.
9 AFE Vincent M. Kerrigan, 2500 Monticello Ave., Chicago, Ill.
9 AFG Everett E. Richardson, Jr., 944 Walnut St., Webster City, Iowa
9 AUZ East Side High School, R. Washington St., Madison, Wisc.
9 BBL Rudolph G. Dahl.....Bryant, S. Dak.
9 BLK George R. Underwood, 521 North "L" St., College View, Nebr.
9 BUU Erwin E. Ricker, 1191½ Third St., Bismarck, N. Dak.
9 CAQ Richard K. Sutherland, Shattuck School, Faribault, Minn.
9 CEG Wilfred James....213 S. Orange St., Cameron, Mo.
9 CVJ Ervin S. Hilts, 2709 First Ave., S., Minneapolis, Minn.
9 CWT William L. Cochrane, 119 W. Wilson St., Carterville, Mo.
9 DLZ George A. Starek 2202 Lincoln Way, W., South Bend, Ind.
9 DNR Melbourne Renken.....Cole Camp, Mo.
9 EEH Joe F. Milde, Jr., 311 E. First South St., Jackson, Mo.
9 EHO Diedrich J. Thies.....Arlington, Minn.
9 YAV Board of Education, 33d and Cuming St., Omaha, Nebr.
9 EZ Culver Military Academy.....Culver, Ind.
9 MN Robert C. Berry, 427 W. Chestnut St., Louisville, KY.
9 UD Paul H. Lamoree.....Akron, Ind.
9 EEO Carl J. Madsen...1329 "N" St., Lincoln, Nebr.
9 EET Cecil R. Yarger.....Massena, Iowa
9 EKO Francis J. Fox, 3501 S. 11th Ave., Minneapolis, Minn.
9 XBG Edmund T. Flewelling, 836 S. St. John's Ave., Highland Park, Ill.

CHANGES

9 BQ Bernard P. Hansen, 703 Oakdale Ave., Chicago, Ill.
9 FS Edward E. Pippenger, 806 S. 7th St., Goshen, Ind.
9 LW Robert R. Spooner, 2933 S. 28th Ave., Minneapolis, Minn.
9 TE Clifford Chilson...7425 S. Shore Drive, Chicago, Ill.
9 UU Roy W. Weisbach.....6727 Yale Ave., Chicago, Ill.
9 AAK Charles H. Atchisson, 6839 Flyer Ave., St. Louis, Mo.
9 AMW Howard H. Smith, 204 W. Nevada St., Urbana, Ill.
9 AVA Griffith M. Morgan, 845 S. Scoville St., Oak Park, Ill.
9 AVR Floyd E. Philips, 200 Jennings Ave., Hot Springs, S. Dak.
9 AZC Charles R. Shaffer, P. O. Box No. 46, Winona Lake, Ind.
9 BBH Leo J. Hruska, 2619 Bever Ave., Cedar Rapids, Ia.
9 BCH Erwin A. Rasmussen, 205 Parkway, Oshkosh, Wisc.
9 CJU James A. Lowe.....675 Knox Court, Denver, Colo.
9 DGZ M. S. Williams and H. K. Jack, 4716 Colfax Ave., S., Minneapolis, Minn.
9 BOU Thomas L. Dooly, 5109a Delmar Ave., St. Louis, Mo.
9 BQO Clarence R. Shenberger, 117 W. Forrest St., Marengo, Ill.
9 BWP Edward J. Posselt....5317 W. 25th St., Cicero, Ill.
9 BZC Walter J. Cahill.....Oakland, Nebr.
9 BZD Samuel M. and Charles C. Wene, 1607 Almlee St., Chicago, Ill.
9 CPW John E. Cook....1713 Arlington, Independence, Mo.
9 CVR Albert B. Marshall, 316 Caldwell St., Louisville, Ky.
9 CXC Albert W. Brown, 315 N. Meridian St., Lebanon, Ind.
9 CYT Grover S. Dale, 779 First St., N. E., Linton, Ind.
9 DFZ Almon W. Sprague, 782 Edmund St., St. Paul, Minn.
9 DHQ C. Fred'k Wolcott, 2817 Thayer St., Evanston, Ill.
9 DPC Vincent A. Wirth, 1906 S. Keeler Ave., Chicago, Ill.
9 DPE Lonnie H. Webb, 2137 Oxford St., Indianapolis, Ind.
9 EEM Charles E. Wells, East Mill St., Richland Center, Wisc.
9 SM Paul A. Perry 218 Washington Blvd., River Forest, Ill.
9 ABF Robert J. Woolsey, 7242 Oleander St., Chicago, Ill.
9 ADE Charles E. Gutke, 4115 Lafayette St., St. Louis, Mo.
9 AGN James E. Walden, 7359 Champlain Ave., Chicago, Ill.
9 AZX Hubert G. Tudor, 3720 S. Washington St., Marion, Ind.
9 CAL Glendon A. Klein.....Blue Earth, Minn.
9 CCV Ed. Barrickiow, 223 E. Sixth St., Concordia, Kans.
9 CMC Homer A. Huber....2656 "I" St., Granite City, Ill.
9 DFV Warren D. Birkenhead, 410 Addison Ave., Elmhurst, Ill.
9 DNV Daniel M. Pottgieser, 1160 E. Rose St., St. Paul, Minn.
9 CH C. Haysmer Thompson, 1526 S. 29th St., Omaha, Nebr.
9 FF Arthur B. Church, 103 Bowen St., Independence, Mo.
9 BYB Eeta Beta Pan Fraternity, 5401 Ellis Ave., Chicago, Ill.
9 DAU Drew D. MacDougal.....Nichols, Iowa
9 DBZ Maurel F. Ohman, 783 Iowa Ave., Huron, S. Dak.
9 DCG Ray E. Ladendorff.....Burt, Iowa
9 DCL Ellery L. Plotts.....Hampton, Nebr.
9 DEJ Lee E. Pedigo, 1830 Benton Blvd., Kansas City, Mo.
9 DGR Dwight M. Pasek, 730 Illinois St., Huron, S. Dak.
9 DGZ S. W. Williams & H. K. Jack, 4716 Colfax Ave., S., Minneapolis, Minn.
9 DHY L. J. Bowers.....Mound, Minn.
9 DIB Thomas S. Wildman, Nichols Ave. and High St., Nichols, Iowa
9 DKN Arthur R. Gasth, 1326 S. 28th St., Omaha, Nebr.
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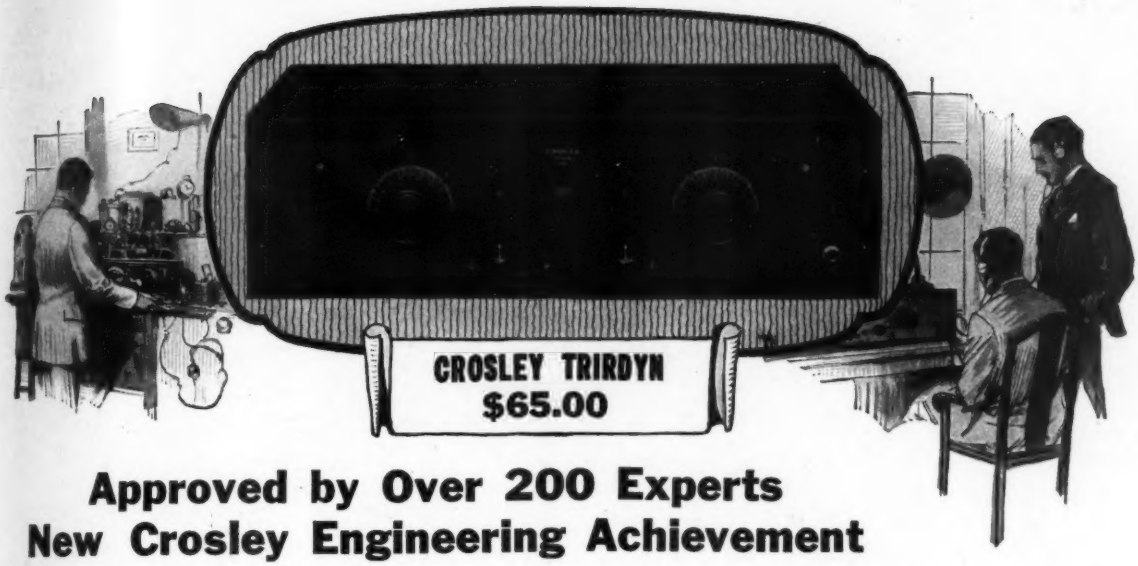

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